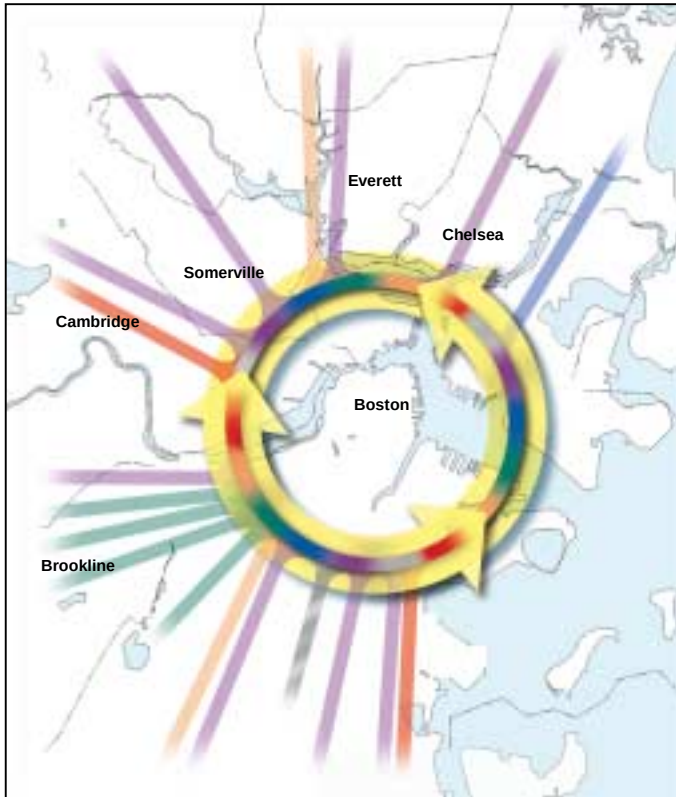




***Major Investment Study
of Circumferential
Transportation
Improvements in the Urban
Ring Corridor***

**MIS
FINAL
REPORT**



July 2001



Massachusetts Bay
Transportation Authority



U.S. Department of Transportation
Federal Transit Administration

The Urban Ring Major Investment Study (MIS)

Preface

The Urban Ring Major Investment Study (MIS) has been, and continues to be, a cooperative effort between the Massachusetts Bay Transportation Authority (MBTA) and the local jurisdictions comprising the Urban Ring Corridor to identify, define, and evaluate alternatives for improving circumferential transportation service. The MIS examined a very wide range of alternatives to meet the transportation needs of the corridor in coordination with local and regional land use and economic plans and policies. The MIS drew upon strong grassroots support and input from public workshops and outreach meetings held throughout the duration of the study. Through this process the MIS developed new concepts to meet existing and projected transportation needs while drawing upon, where relevant, the many professional and community based ideas that have been articulated over the long history of the project.

The following agencies and jurisdictions were involved in this cooperative effort:

- Massachusetts Bay Transportation Authority
- Executive Office of Transportation and Construction
- Federal Transit Administration (Lead Federal Agency)

This MIS Final Report was prepared for the Massachusetts Bay Transportation Authority by the consultant team headed by Earth Tech, Inc. with ridership forecasting and demographic data supplied by the Central Transportation Planning Staff (CTPS).

The Urban Ring Working Committee, Steering Committee, and Technical Subcommittees provided review and input throughout the study. The results of this study are intended to provide the basis for implementation of Phase 1 improved bus service; the commencement of a DEIR/S for Phase 2; and at a later date, the DEIR/S for Phase 3.

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INTRODUCTION

The planning and project development process for the Urban Ring was initiated in early 1996 and has followed the Federal Transit Administration guidelines for Major Investment Studies in effect at the start of the study. The process has been updated to reflect changes in those guidelines that have occurred since then.

The Urban Ring Major Investment Study (MIS) Final Report describes the development and evaluation of a wide range of transportation alternatives for serving the growing crosstown corridor outside downtown Boston, and outlines a strategy and schedule for phased implementation of the recommended alternatives. By reducing transit trip times, the alternatives identified in the MIS will achieve both major diversions of auto trips to the transit system and greatly increased mobility for transit users. The alternatives will provide direct transit access to locations and low income and minority populations currently underserved while supporting access to jobs and infill development. By connecting with every commuter rail line, radial transit line and most of the bus system, the Urban Ring will reduce congestion on local buses and the rail system in the Core of Boston and increase system ridership.

The roughly circular Urban Ring Corridor (the Corridor) includes portions of Chelsea, Everett, Somerville, Cambridge, Brookline and Boston. Approximately 15 miles long and 1 mile wide, the Corridor is growing faster than the regional average and will contain over 314,000 residents and over 360,000 jobs by the year 2025. Every Massachusetts Bay Transportation Authority (MBTA) commuter rail, heavy and light rail transit line, and the Silver Line currently under construction, as well as over half of all MBTA bus routes, currently cross the Corridor, yet directness of transit travel along the Corridor today remains poor. This poor performance is largely due to the indirect routing that transit travelers must currently use for crosstown trips, compounded by inefficient connections with the radial transit and commuter rail system.

To address these needs, the MIS developed alternatives ranging from low-cost conventional buses to Bus Rapid Transit (BRT), rail systems and various combinations of each. Each alternative was evaluated to identify benefits, costs and potential environmental issues. A community-based planning process was used throughout the study, including extensive participation from citizen, business and environmental groups, and municipalities, as well as representatives from many of the areas largest educational and medical institutions. The extensive public involvement program included workshops, outreach briefings and general public meetings with a Working Committee and its Subcommittees, providing input and guidance throughout the process.

Through this public process, the range of alternatives was steadily reduced from 15 down to three. All three alternatives consist of Transportation System Management (TSM) measures, Bus Rapid Transit (BRT) service, and Supporting Elements such as new commuter rail stops at Urban Ring interfaces. They differ in the type of rail service included. Alternatives A1 and B include Light Rail while Alternative A2 utilizes Heavy Rail. A multi-phase implementation concept and schedule was developed where each phase builds upon the previous phase until all the elements of the alternatives are in place.

Phase 1: New and improved crosstown and express buses (2001-2005)

Phase 2: Bus Rapid Transit system with new or improved commuter rail connections (2006-2010)

Phase 3: Light or Heavy Rail between Assembly Square and Dudley Square (2011-2015)

By Phase 3, each alternative would connect with all existing and planned transit and commuter rail lines, carry nearly 300,000 riders daily, save travelers approximately 50,000 hours daily, increase systemwide transit ridership by 47,000 daily, and relieve bus and core subway congestion effectively increasing system capacity. Moreover, each alternative is consistent with and supported by local and regional land use and economic development policies, and is capable of being phased incrementally over time. The Phase 3 alternatives feature a rail system approximately 6 to 7 miles in length in the most heavily traveled portion of the Corridor, integrated with the Phase 2 high-frequency Bus Rapid Transit (BRT) routes on both ends and the Phase 1 new and improved crosstown and express buses. Local bus routes act as feeders to both the rail and BRT routes.

The MIS Final Report summarizes the development and evaluation of the alternatives and the phased approach recommended for its implementation. The report is organized as follows¹:

Chapter 1	Purpose and Need
Chapter 2	Corridor Characteristics
Chapter 3	Alternatives Considered
Chapter 4	Transportation Impacts
Chapter 5	Environmental Consequences
Chapter 6	Economic Development and Land Use
Chapter 7	Capital, Operating and Maintenance Costs
Chapter 8	Evaluation
Chapter 9	Next Steps

Also included for reference are a number of Appendices containing useful reference material providing additional details in the following areas:

Appendix A	Glossary and Abbreviations
Appendix B	Committees and Preparers
Appendix C	List of Technical Memoranda and Related Reports
Appendix D	Right-of-Way Preservation
Appendix E	Station Urban Design and Section Study

A unique feature of the Urban Ring planning process has been the extraordinary level of cooperation and coordination between the MBTA and the municipalities that comprise the Urban Ring Corridor. In a virtually unprecedented action, these six jurisdictions formed a Regional Planning Compact for the sole purpose of jointly planning and supporting the Urban Ring transit project. The result has been a high degree of participation and collaboration between regional and local transportation, land use and economic development agencies.

The Working Committee, its Subcommittees and the Compact municipalities will continue to be active participants throughout the environmental process following the MIS, underscoring the strong grassroots support and close coordination of transportation and land use planning that are the hallmarks of the Urban Ring project.

¹ An Executive Summary of the MIS Final Report, not contained herein, is bound separately.

Chapter 1

PURPOSE AND NEED

1.0 PURPOSE AND NEED

This chapter discusses the purpose and need for transportation improvements in the Corridor. It presents a background summary of the project planning process and history, and an overview of the Corridor and its existing and baseline future transportation facilities and services. Mobility problems anticipated in the future are identified. The Urban Ring Regional Planning Compact, which serves as the mechanism for coordination between transportation planning and land use in the Corridor, is also described. Transportation goals and objectives for the Corridor are established along with evaluation measures. The chapter concludes with a description of the extensive Urban Ring MIS public involvement program.

1.1 Project Background

The cornerstone of the Urban Ring MIS planning process has been the extraordinary level of cooperation and coordination between the MBTA and the six jurisdictions that comprise the Urban Ring Regional Planning Compact (Compact). The result has been an unprecedented level of coordination between regional transportation planning and regional and local land use and economic development goals. In many ways the Compact is the culmination of decades of public debate and analysis of a transportation need that was first identified in the early 1900's. Provided below is a summary overview of the Urban Ring MIS planning and development process, followed by summary timeline of previous studies providing historical perspective to the strong community based support for transportation improvements in the Corridor and details of the public involvement program. A more detailed documentation of the project background is contained in the MIS Progress Report dated April 2000.

1.1.1 Planning and Development Process

The planning and project development process for the Urban Ring has followed the Federal Transit Administration (FTA) guidelines for Major Investment Studies in effect in 1997. Since then, TEA 21 legislation has caused FTA to initiate changes to integrate the planning principles of the MIS into the environmental process. The basic steps in the Urban Ring planning process are listed below and described in the following sections.

- Define purpose and need
- Develop goals, objectives and evaluation measures
- Develop alternatives
- Describe potential impacts
- Evaluate alternatives

1.1.2 Historical Perspective

The idea of transportation improvements in the Urban Ring Corridor has been the subject of considerable public debate and analysis dating back to the era when a system of circumferential highways were proposed and later abandoned. The 1970's marked a period of fundamental change in state policy away from highways and in favor of transit based solutions to mobility problems. Starting with the Circumferential Transit Feasibility Study in 1989, potential ridership in the Corridor began to be quantified and the cost and feasibility of various alternatives was examined in greater detail. Major events in the development of the Urban Ring are listed below. A description of each can be found in the MIS Progress Report dated April 2000.

- **1972 Boston Transportation Planning Review (BTPR).** A diagram of the circumferential transit concept plan from that report is contained in Figure 1-1.
- **1976 Program for Mass Transportation (PMT).**
- **Circumferential Transit Feasibility Study, 1989.** Diagrams depicting the six long range alternatives examined in that study are shown in Figure 1-2.
- **Circumferential Transit Mid-Term Improvement Study, 1993.** A diagram of the limited-stop bus routes recommended in that study is contained in Figure 1-3.
- **The New Urban Ring Charrette, 1993.**
- **The New Program for Mass Transportation (PMT), 1994.**
- **The Urban Ring Regional Planning Compact, 1995.**

The support of local government for transportation improvements in the Urban Ring Corridor reached a major milestone in October 1995 when the chief executive officers of Boston, Brookline, Cambridge, Chelsea, Everett and Somerville signed the Circumferential Ring Regional Planning Compact (Compact). The Compact commits the six cities and towns to initiate a direct role in the MIS. Working through the MBTA, the Compact document states that its six member jurisdictions will work cooperatively so that local land use and economic development planning is coordinated with public transportation planning. Documentation supporting the formation of the Urban Ring Compact included a review of economic growth opportunity, existing employment, pending development, development opportunities, transportation facilities and travel demand characteristics. The Compact suggests there are significant economic development opportunities but deficient transportation service in the Corridor.

Fundamental to the Compact's vision is improved transit access for Corridor neighborhoods as well as employment centers, thereby raising the importance of the neighborhood function beyond the incidental role described in the 1972 BTPR.

The Urban Ring Compact commits the six cities and towns to initiate a direct role in the MIS and, working through the MBTA, the Compact document states that its six member jurisdictions will:

- “- Propose the circumferential corridor to be the subject of the MIS, based on economic development and the other planning initiatives within the municipalities
- Document economic, environmental, social and other conditions and opportunities within the corridor to be addressed by the MIS
- Identify goals and objectives to be pursued by the MIS
- Advise the MBTA on transit service alternatives to be evaluated within the corridor
- Evaluate these alternatives based on the land use, economic development, environmental, and social goals and objectives
- Carry out planning, development, social services, retail, educational, residential and/or parkland projects to be integrated with circumferential transportation projects
- And, on the adoption of transit projects, incorporate the recommended transit elements, together with associate economic development, social services, retail, educational, residential, and parkland projects into our respective municipal General Plans.”

Concurrent with development of the MIS, the Urban Ring Compact jurisdictions have prepared a companion document describing the unified land use and economic development vision of the Compact members and how transportation improvements in the Corridor would support that vision. The Compact Report is consistent with and supportive of the Urban Ring MIS.

1.2 Need for Transportation Improvements

The Corridor has been the subject of many past transportation studies that have focused on two critical mobility needs:

- The first is the need to improve access to the activity centers located within the Urban Ring by developing a circumferential transportation system that connects the radial facilities and provides access among Urban Ring trip generators.
- The second is the need to relieve the growing congestion on the core portions of the radial transit network, which is caused in part by the large number of trips that pass through the core to reach destinations outside the core area.

These studies, which span nearly 40 years, have identified solutions ranging from an “Inner Belt” Highway to a new circumferential rail transit line and new bus routes augmented by low-cost traffic engineering improvements. To date, improvements have been limited and no comprehensive program to address these mobility problems has been implemented. The purpose of the Urban Ring MIS was to review and update the needs assessment using the latest data and, working closely with Corridor stakeholders, identify an implementable long-range plan for addressing those needs.

1.2.1 Overview of the Corridor

The Corridor includes portions of Chelsea, Everett, Somerville, Cambridge, Brookline and Boston as shown in Figure 1-4. Approximately 15 miles long and one mile wide, the Corridor contains numerous Activity Centers¹, including major medical, educational, and cultural institutions, high-density employment, retail, and other trip generating uses, as well as densely populated residential areas. The Corridor is growing faster than the regional average and is projected to have over 314,000 residents and more than 360,000 jobs by the year 2025. The predominantly radial network of roadways and rail transit lines currently passing through the Corridor are oriented to the Boston Core and are highly congested, particularly in Boston, Brookline, and Cambridge. The Corridor includes urban brownfields and both small, isolated pockets and large areas of undeveloped or underdeveloped land. While these areas are less congested than the central portions, they generally suffer from poor mobility as a result of the structure of the existing, primarily radial roadway and transit network. At the northeast end of the Corridor is Logan International Airport, a major Activity Center in its own right.

Transportation facilities in the Corridor include an extensive network of roadways and fixed transit facilities, as well as an extensive system of both public and private transportation services. Most of the fixed facilities radiate from the Boston Core and pass through a portion of the Corridor. With the exception of a few congested crosstown arterial roadways and the limited network of crosstown bus routes that operate over them, few existing transportation facilities or services provide direct crosstown connections between the major trip generators in the Corridor. Moreover, the 2025 “No Build” list of future projects does not address the need for improved Corridor access. A summary description of existing and planned transportation facilities is provided below. A more detailed description of these transportation facilities is contained in the MIS Progress Report dated April 2000.

1.2.2 Transportation Facilities and Services in the Corridor

Transportation facilities in the Corridor include an extensive network of roadways and fixed transit facilities, as well as an extensive system of both public and private transportation services. Most of the fixed facilities radiate from the Boston Core and pass through a portion of the Corridor. With the exception of a few congested arterial roadways and the limited network of crosstown bus routes that operate over them, few transportation facilities or services provide direct crosstown connections between the major trip generators in the Corridor. Transportation improvements contained in the current Regional

¹ Activity Centers are land use nodes at which there is an existing or potential concentration of one or more land uses that would generate a substantial number of trips..

Transportation Plan for the Year 2025 do not address the need for circumferential transit improvements in the Urban Ring Corridor.² A more detailed description of existing and planned transportation facilities in the Corridor is provided in Chapter 2.

1.2.3 Transportation Related Issues

The Corridor has been the subject of many past transportation studies that have focused on several critical transportation needs. These studies, which span nearly 40 years, have identified solutions ranging from an “Inner Belt” Highway to a new circumferential rail transit line and new bus routes augmented by low-cost traffic engineering improvements. To date, improvements have been limited and no comprehensive program to address these mobility problems has been implemented. The purpose of the Urban Ring MIS was to review and update the needs assessment using the latest data and, working closely with the Compact communities, identify an implementable long-range plan for addressing the following:

- *Accessibility of the Corridor Transit System and Mobility of its Users is Inadequate:* The Corridor includes a large percentage of minority and transit dependent low-income households with lack of access to an automobile. There is a need to provide convenient high quality transit connections between emerging and established activity centers and neighborhoods located along the Urban Ring Corridor, as well as between the Corridor and the balance of the Region, while reducing transit travel times.
- *Transit Congestion in the Boston Core Remains a Problem:* Other planned capacity improvements don't address a major cause of this congestion - the large and growing number of transit riders that must pass through the Boston Core in order to reach destinations along the Urban Ring Corridor.
- *The Environment is Negatively Impacted by High VMT and Congestion:* Established activity centers in the Corridor are impacting neighborhoods with traffic while emerging areas, including brownfield sites, lack good access to attract investment.
- *Economic Development is Constrained by Traffic Congestion and Poor Access:* It limits the development capacity of established areas and holds back emergent areas from reaching their full potential.
- *Needs are Immediate and Growing Rapidly:* A cost-effective phased approach is needed to start improvements immediately while building systematically toward the proposed long-range alternative.

A complete analysis of the travel market demand was conducted as part of the Urban Ring MIS in 1997-98 and is documented within Chapter 1 of the Urban Ring Progress Report dated April 2000, the supporting appendices of that report, and a separate technical memo.

1.2.3.1 Transit Accessibility and Mobility is Inadequate

The lack of circumferential connections in the Corridor has significant implications for accessibility within both the Corridor and the larger region. Access to activity centers (locations that generate a significant number of trips) and neighborhoods is often circuitous and slow. Roadway access requires travel on the limited number of congested crosstown arterials, or into and then out of Downtown Boston using the highly congested radial roadway network. Travel via the transit system is equally constrained. The options on the transit network include use of the crosstown bus network, which suffers from the limitations of the roadway network, or circuitous routing via the congested radial rapid rail and LRT network and a transfer between lines in the central subway in Downtown Boston. Existing rail transit stations are concentrated along radial corridors that leave large geographic areas beyond convenient walking

² Source: Regional Transportation Plan Update (Interim), March 2001, CTPS/MAPC. Inclusion of Phase 1 and 2 of the Urban Ring in the final version of the RTP was under consideration by the MPO at the time the MIS Final Report was prepared.

distance. This distance increases as you move away from the downtown core of Boston as the radial lines fan out leaving the areas between the “spokes” of the rail transit system dependent on increasingly congested bus service. This results in long trip times between areas that are relatively close together and places a disproportionate burden on the large percentage of transit dependent residents in the Corridor. It also produces, for households with access to one, a higher propensity to use the auto than might occur given the high levels of transit service and high levels of parking cost and congestion in the central portions of the Corridor. Year 2000 census data shows minorities comprise 45 percent of the total Corridor population compared to 21 percent of total regional population. Moreover, average household income in the Corridor is only 62 percent of average household income in the region (1990 Census is most current data for household income).

For origins external to the Corridor within the existing transit system, an average of 1.4 transfers per transit trip is needed to reach points within the Corridor, at an effective average speed of approximately 15 miles per hour. In contrast, for origins within the Urban Ring Corridor, an average of 1.2 transfers per transit trip is needed, but the average speed is less than 8 miles per hour. This slow speed is in part reflective of the MBTA's need to serve the predominant flow of traffic into the Boston Core. The result is the need for transit trips within the Corridor to travel relatively greater distances via the core and then out to reach these outlying destinations along the Corridor. As a point of comparison, the average number of transfers for the overall Boston metropolitan region is only 0.71 transfers per transit trip. Thus, the average number of transfers required for transit trips to and from the Urban Ring Corridor is currently twice the average for the metropolitan region.

Without the Urban Ring, the transit system of the future will not accommodate these important regional access requirements. The 2025 “No Build” transit and commuter rail system provides additional radial services, but does not address crosstown accessibility and mobility problems described above.

1.2.3.2 Inner Core Rapid Transit Congestion Remains a Problem

The high reliance on the radial transit network and the large number of Urban Ring trips that pass through the Boston Inner Core adds to the growing levels of congestion on the central portions of the MBTA rail network. Capacity problems currently exist on the Blue Line and the western leg of the Green Line. Improvements in the central subway system as part of the Long-Range Regional Transportation Plan will provide some additional capacity. However, these improvements only marginally increase Core capacity and do not address a major cause for the congestion – namely a system configuration that forces many transit users to pass through the Inner Core to reach destinations along the Urban Ring Corridor. The rapidly increasing demand placed on the system by this pass-through transit traffic is expected to consume the planned new capacity in the central subway system, particularly on the Green Line.

The contribution of Urban Ring trips to these subway congestion problems varies by line. As many as 40 percent of all rail line unlinked trips involve either a boarding (entrance of rail vehicle) or alighting (exit of rail vehicle) in the Corridor. This percentage is highest for the Green, Orange and Blue Lines. While smaller, the percentage for the Red Line is significant at an estimated 30 percent. While many of the trips to and from Urban Ring locations also involve an origin or destination in Downtown Boston, a large percentage do not, and travel to the Boston Core only to transfer to another line or ride through to a destination outside the Boston Core. Diverting Urban Ring trips to new crosstown transit facilities outside Downtown Boston would greatly reduce the demand on the core rapid transit system and thereby extend the effective capacity of those systems and the need for additional capacity expansions beyond those already planned.

1.2.3.3 The Environment is Negatively Impacted

Without the infrastructure to support transit-oriented development in the Corridor, auto-oriented development will continue with its associated environmental impacts. These impacts include a lessening of air quality, increase in ambient noise, and the inefficient use of scarce land for parking, roadways, and other auto-related uses.

1.2.3.4 Economic Development is Constrained

Roadway traffic congestion and poor transit access pose significant impediments to economic development in many areas of the Corridor. It limits the development capacity and quality of life in established areas and can hold back emerging areas from reaching their full potential. Within the central portions of the Corridor between the Crosstown/Ruggles area in Boston and the Lechmere/North Point area of Cambridge, the combination of high levels of traffic congestion and limited regional transit access places limits on further development of many activity centers. This portion of the Corridor, most notably in East Cambridge and around the Longwood Medical Area of Boston, contains well-established employment centers, yet is constrained by lack of crosstown transit. Other areas include the southeast portions of the Corridor in Boston and the northern portions of the Corridor in the municipalities of Somerville, Everett and Chelsea. The economies of these municipalities are re-emerging and actively seek better transit to support development of their sites, including brownfields. Most of these areas are currently limited to auto-oriented uses due to lack of transit service, which would be a prerequisite for higher density mixed-use development. Local and regional land use policies would generally favor much higher development densities with improved transit access and reduced dependence on auto travel.

1.2.3.5 Needs are Immediate and Growing Rapidly

The already congested Corridor is projected to grow at three times the rate of the region as a whole, yet no increase in crosstown transit capacity is currently programmed. Between 1990 and 2025 the population of the Corridor is projected to grow 34 percent compared to 11 percent for the region as a whole, and employment in the Corridor is projected to grow 81 percent compared to 26 percent for the region as a whole. Along with this growth will be a commensurate increase in trip making. Cost-effective improvements to crosstown transit access are needed in the near and mid-term while the more substantial capital, environmental, design, and construction challenges of the long-range project are addressed. The corridor contains existing and abandoned railroad rights-of-way, transit easements dating from the failed Inner Belt Highway, and existing transit facilities with expansion potential, all of which present opportunities for incrementally building a cost-effective network of transit services in the Corridor.

1.2.4 Goals and Objectives

Ten primary goals have guided the process of alternatives development and evaluation of Corridor mobility improvements. The Urban Ring goals and the associated objectives and potential evaluation measures were developed and adopted by consensus through the extensive public involvement process described in Section 1.3. The process was consistent with MIS planning guidelines that emphasize the use of locally adopted goals and objectives.

1.2.4.1 Improve Access for All Corridor Origins and Destinations for All Users

Mobility improvements in the Urban Ring should result in significant improvements in the ability to move people along the Corridor and between the Corridor and the balance of the region. Improvements should increase accessibility for all users, including Corridor residents, employees, students, visitors, shoppers and users of the many medical, educational, cultural, retail and recreational facilities in the Corridor. Improvements should reduce travel times, increase transportation system capacity and decrease circuitous routing. In addition, the Corridor contains a large economically disadvantaged population for whom non-auto access to jobs and other economic opportunities should be improved.

Under federally established MIS guidelines, all Urban Ring alternatives must be evaluated in comparison to both the low-cost Transportation System Management (TSM) alternative and the "Do Nothing" Alternative, also known as the "No Build" Alternative. Accordingly, the following evaluation measures were adopted during the public process and will be used to compare alternatives to each other and to the TSM and "No Build" Alternatives:

- Total change in the absolute number of transit trips with an origin and/or destination in the Corridor.
- Total transit travel time savings for all Corridor trips.
- Total change in number of transfers for all Corridor transit trips.
- Change in overall transit mode share for Corridor trips.
- Change in accessibility indices for trips along the Corridor and to and from the Corridor and locations elsewhere in the region.

1.2.4.2 Improve Crosstown Access for Non Single Occupant Vehicle (SOV) Users

Mobility improvements in the Urban Ring Corridor should improve crosstown access and link crosstown movements to the existing highly developed radial network in an integrated and seamless manner. Improvements should facilitate crosstown transit, other high occupancy vehicle, pedestrian and bicycle travel.

Measures by which alternatives would be evaluated in comparison to both the TSM and No Build Alternatives include:

- Qualitative assessment of overall crosstown network connectivity, integration and ease of transfer with the existing radial network.
- Change in total travel time by transit between selected subareas in the Corridor.
- Qualitative assessment of the impacts on Corridor travel by non-motorized means.

1.2.4.3 Reduce Congestion on the Existing Radial Transit Network

Mobility improvements in the Urban Ring Corridor should at a minimum reduce the forecast growth in radial rapid transit and LRT transit network congestion, and result in an absolute reduction over current levels. Thus, Corridor improvements should free capacity for additional radial travel and reduce the need for additional expansion of the radial transit.

A measure by which alternatives would be evaluated in comparison to both the TSM and “No Build” Alternatives includes:

- Forecast volume to capacity ratios for the peak load points on the Red, Orange, Blue and Green Lines.

1.2.4.4 Reduce the Growth in Overall Single Occupant Vehicle (SOV) Travel

Mobility improvements in the Urban Ring Corridor should divert travel from the single occupant automobile and thereby reduce the growth of vehicle miles of travel in both the Corridor as well as the region.

Measures by which alternatives would be evaluated in comparison to both the TSM and “No Build” Alternatives include:

- Forecast change in regional vehicle miles of travel (VMT).
- Forecast change in the number of SOV trips made in the region.
- Select subarea VMT changes in the most highly congested areas.

1.2.4.5 Contribute to the Attainment of National, State, Regional and Local Community Environmental Goals

Mobility improvements in the Urban Ring Corridor should contribute to the attainment and long-term maintenance of conformity with National Ambient Air Quality Standards. In addition, mobility improvements should improve overall environmental conditions in the Corridor and minimize any site-specific negative impacts. Finally, the mobility improvements should conform to the requirements of Executive Order 12898 that is intended to promote nondiscrimination in federal programs substantially affecting human health and the environment. The Order requires that federal programs be assessed to assure they do not have either direct or indirect discriminatory impacts on minority or low-income populations.

Measures by which alternatives would be evaluated in comparison to both the TSM and “No Build” Alternatives include potential impacts on:

- Regional and localized air quality.
- General noise implications of transit technologies.
- Historic and archeological resources.
- Water resources.
- Parklands.
- Hazardous materials, including beneficial impacts to brownfield sites.
- Regional energy consumption.
- General transportation safety.
- Minority and low-income communities.

1.2.4.6 Reduce Transportation Related Impediments to Economic Development

Mobility improvements in the Urban Ring Corridor should reduce current accessibility related impediments to economic development in the Corridor. Existing transportation impediments include physical barriers to access and movement, a number of which are caused by existing transportation facilities; impediments to pedestrian access; and transit system, roadway and parking congestion. Non-transportation impediments include the existing character of a number of areas, current land use policy and zoning, and real estate economics. While mobility improvements alone will not necessarily stimulate economic growth, congestion and the lack of access can be major impediments to further development and redevelopment. In addition, in areas with underdeveloped or deteriorated transportation infrastructure, mobility improvements can result in market attention that could stimulate growth.

Measures by which alternatives would be evaluated in comparison to both the TSM and “No Build” Alternatives include:

- Qualitative assessment of the implications of the mobility improvements on economic development.
- Change in accessibility indices.
- Change in transit share (mode split), as a surrogate measure for the possible reduction in parking demand rates.

1.2.4.7 Support Local, Regional, State and Federal Development Goals

Both the public and private sectors continue to make significant investments throughout the Urban Ring Corridor. Mobility improvements in the Corridor should support these actions by providing the transportation infrastructure needed to accommodate the forecast growth and assure the viability of the

large public and private investments that are being made in the area. Improvements should support local goals of improving the attractiveness of the communities in the Corridor. Additionally, improvements should be consistent with local, regional, state, and federal goals related to encouraging concentrated development and discouraging suburban sprawl.

Measures by which alternatives would be evaluated in comparison to both the TSM and “No Build” Alternatives include:

- Qualitative assessment of the degree to which transportation improvements reinforce major public and private investments in the Corridor.
- Qualitative assessment of the degree to which transportation improvements add to the urban fabric and visual attractiveness of the Corridor.
- Qualitative assessment of the degree to which transportation improvements support concentrated development and discourage suburban sprawl.

1.2.4.8 Improve the Efficiency and Effectiveness of Buses and Other Rubber Tire Transit Services

Regardless of the transportation improvements made in the Urban Ring Corridor, the existing system of both public and private bus services will continue to play a significant role in the overall movement of people in the Corridor. Today, the largest volume of public transportation trips in the Corridor are made on the MBTA local bus system, and even with implementation of a major new transit technology, local buses will continue to play a major role in the area's mobility. Mobility improvements in the Corridor should result in improvements in the speed, efficiency and attractiveness of local buses.

Measures by which alternatives would be evaluated in comparison to both the TSM and “No Build” Alternatives include:

- Forecast change in operating cost per passenger-mile for the MBTA bus system.
- Qualitative assessment of the change in travel times for selected trips on the bus system within the Corridor.
- Qualitative assessment of the impacts of Urban Ring Corridor mobility improvements on the overall attractiveness of the bus system serving the Corridor.

1.2.4.9 Support the Phased Implementation of an Integrated Transportation and Land Use Vision for the Corridor

To gain the most from transportation investments in the Urban Ring Corridor, other supportive public land use and investment actions must be undertaken. The private sector must also be in a position to respond to these actions with investments that will foster development compatible with the transportation investment. Corridor mobility improvements should be developed and implemented as part of a comprehensive set of public and private actions designed to achieve a unified vision for the entire Corridor, key Corridor subareas and the region, as a whole.

Suggested measures by which alternatives would be evaluated in comparison to both the TSM and “No Build” Alternatives include:

- Qualitative assessment of the degree to which regional and local land use policies are likely to foster transit supportive land use.
- Quantitative and qualitative assessment of the degree to which the real estate market is likely to support transportation improvements in the Corridor with compatible land use investments.

1.2.4.10 Develop a Cost Effective, Implementable Preferred Investment Strategy for Mobility Improvements

Given the large transportation needs in the region and the limited funding resources at all levels, the identified mobility improvements should be cost effective and capable of being phased over time to reflect the most likely flow of resources. In addition, the implementation strategy for improvements should attract new and creative ways to both fund and deliver project elements.

Measures by which alternatives would be evaluated in comparison to both the TSM and “No Build” Alternatives include:

- Total capital cost.
- Annual operating and maintenance costs.
- Federal Transit Administration (FTA) cost effectiveness index.
- Qualitative assessment of phasing opportunities.
- Qualitative assessment of private sector project delivery and funding opportunities.

1.3 Public and Agency Participation Program

To assure that the Urban Ring Major Investment Study reflects the public consensus regarding transit improvements in the project corridor and throughout the region, the MBTA has developed, implemented, and managed an extensive program of participation for area residents; business, civic, and environmental organizations; and government agencies. This program also assures compliance with federal and state guidelines regarding public participation in major transit investment projects in accordance with 49 CFR Part 611.

In summary, the Urban Ring public and agency participation program has:

- Created and maintained a mailing list of approximately 2,500 participants and interested individuals;
- Sponsored or participated in more than 80 public, community, and agency meetings;
- Involved more than 400 participants and meeting attendees;
- Generated hundreds of comments from members of the public and agency representatives;
- Published two informational brochures during the course of the study and distributed them to the full mailing list and at various forums. A third brochure summarizing the MIS Final Report is planned for distribution in Fall 2001.

This section of the MIS Final Report describes the Public and Agency Participation Program, its participants and their roles, and program activities. This section also incorporates by reference detailed support materials, such as minutes of public meetings, documented in a separate technical memo.

1.3.1 Program Summary

The MBTA's Urban Ring MIS Public and Agency Participation Program rests on a foundation of regional support and municipal cooperation. The depth of this support dates back 30 years to the rejection of the I-95 Inner Belt Highway and the continued growth in support for improved circumferential transit. The MBTA initiated the Urban Ring MIS largely in response to the strong interest in improved circumferential transit expressed by numerous parties. Foremost among them are the Regional Planning Compact representing the six cities and towns in the Corridor; the Boston Society of Architects Infrastructure Forum; the Circumferential Transit Employers Committee (CTEC) and the Medical and Scientific Community Organization (MASCO) representing companies and institutions; Move Massachusetts; and

the Conservation Law Foundation. Many other business and citizens' groups have also supported the Urban Ring during the MIS process. The support of these groups has been invaluable to the public involvement effort.

In late 1996, the MBTA established the Urban Ring Working Committee to serve as an umbrella forum for public and agency participation. Since then, the Working Committee has served as the principal organization through which public and agency participants have channeled their energy, knowledge, resources, and creativity to develop an integrated concept for transportation and land use to improve accessibility in the Urban Ring Corridor and throughout the Greater Metropolitan Region.

In early 1997, the Working Committee adopted the MIS Public and Agency Participation Program. The program is geared to maximize public participation and minimize the duplication of outreach activities by piggybacking on the structure and activities of the Working Committee as much as possible. Because of the Urban Ring's potential benefits to the entire MBTA service area, the Public and Agency Participation Program includes outreach strategies and procedures to foster participation in a broad geographic area, incorporate multiple communities and municipalities, and promote the flow of information among numerous stakeholders.

On December 7, 2000, the Federal Transit Administration enacted revised rules and guidelines for Major Capital Investment Projects in 49 CFR Part 611. The Urban Ring public and agency participation program is consistent with these revised rules and guidelines, which are substantially unchanged with respect to public and agency participation since the passage of the Transportation Equity Act for the 21st Century (TEA-21) on June 9, 1998. TEA-21 integrated the MIS requirement into FTA/FHWA planning and environmental regulations in 23 CFR Part 450 and 23 CFR Part 771. While this change eliminated the need for a separate MIS for subsequent major capital investment projects, it did not affect or substantially alter the public and agency participation requirements for such studies in progress before June 9, 1998, including the Urban Ring MIS. Further updates to the FTA New Starts program are underway that are expected to be issued later this year.

1.3.2 Participants and Roles

At the outset, the Public and Agency Participation Program established and defined the responsibilities and relationships among the MIS participants. In addition to the MBTA and the Consultant Team, the principal participants included:

- The Working Committee;
- The Steering Committee;
- Subcommittees of the Working Committee;
- Local government agencies, including those of the six Urban Ring Compact Communities (Boston, Brookline, Cambridge, Chelsea, Everett and Somerville);
- Community organizations and institutions, including numerous neighborhood groups, employer associations, academic and medical institutions, civic associations, as well as individual residents.

The following sections describe these participants and a chart depicting the committee organization is provided in Figure 1-5.

1.3.2.1 The Working Committee

The Working Committee served as, and continues to be, the primary forum for public interaction for Urban Ring planning activities, including the MIS. The Working Committee is drawn from a group of more than 200 interested individuals who serve on a volunteer basis or as representatives of their respective organizations including government agencies, municipalities, regional organizations, and institutions. Working Committee members represent a broad cross section of interests from transportation,

environment, commerce, education, medicine, urban planning and architecture. Approximately 50 (but as many as 100) committee members typically attend each meeting.

As an entity composed of both public and private sector representatives, the Working Committee is well suited to guide the development of Urban Ring concepts, alternatives and evaluation criteria. The Working Committee is also the venue where members of the public are able to express interests and concerns on a continuing basis, and where the MBTA and Consultant Team have been able to receive new ideas and suggestions for consideration and incorporation into the MIS. Finally, the Working Committee and its subcommittees provide forums for the presentation of technical work by the Consultant Team for review and comment. The Working Committee has also been closely involved in the development of materials for workshops and public meetings (see Paragraph 1.3.4).

1.3.2.2 The Steering Committee

The Steering Committee functions as an executive committee of the Working Committee. Its members include the chairs of each subcommittee and representatives from the six Urban Ring Compact communities. The Steering Committee meets more frequently than the Working Committee, reviewing technical data, work products, and overall project progress. The Steering Committee helps preview and refine materials before they are presented to either the Working Committee and/or the general public. Like Working Committee meetings, Steering Committee meetings are open to the public.

1.3.2.3 Subcommittees

To provide forums for more in-depth explorations of issues related to the Urban Ring, the Working Committee established five subcommittees in early 1997. The subcommittees are composed of members of the Working Committee. The subcommittees were formed to research and gather additional public input on six general subject areas of the MIS planning effort: Public Participation, Forecasting and Modeling, Options and Alternatives, Economic Development and Land Use, Operations and Users, and Financing Options. After MIS activities were under way during the first six months of 1997, the Steering Committee reduced the number of committees from six to four by consolidating the activities of the Options and Alternatives, and Operations and Users Subcommittees with those of the Economic Development and Land Use Subcommittee. In 2000, the Steering Committee created a fifth subcommittee to examine issues of Environmental Justice.

Summaries of subcommittee activities are provided below.

° Public Participation Subcommittee

The Public Participation Subcommittee developed the program of public and agency involvement to support the Urban Ring MIS and the MBTA's ongoing related planning initiatives. This subcommittee generated the initial lists of names to create the first project mailing list and provided considerable help in identifying civic and community groups to be contacted as part of the outreach effort. Local groups have been offered presentations sometimes on more than one occasion during the course of the study. In addition, the Public Participation Subcommittee organized an intensive daylong Legislative Briefing for the Massachusetts House of Representatives and State Senate on the Urban Ring MIS project and findings to date.

° Forecasting and Modeling Subcommittee

The activities of this subcommittee focused on the review and comment of inputs and outputs to travel and demand forecasts. The Subcommittee evaluated model assumptions as well as updates to the model as it developed during the course of the study. Station locations, vehicle headways and similar variables to the input were all carefully reviewed. The primary task of the Subcommittee was to provide technical oversight to development of sound ridership projections for the Urban Ring alternatives as forecasts and models were developed and refined.

◦ **Economic Development, Land Use and Zoning Subcommittee**

Economic development and land use has been a prime topic of interest to the Compact Communities whose municipal powers include the zoning authority needed to succeed with joint development and/or transit related development associated with Urban Ring alternatives. This subcommittee was instrumental in providing the local input necessary to define local land uses both present and projected, as well as municipal priorities for where development should and should not occur. This land use information was used for predictive economic development modeling.

Similarly the Economic Development and Land Use Subcommittee carefully reviewed and critiqued all Urban Ring alignment options and mode choices as they were developed. Their input was very influential in the refinement process of alternatives and in the consolidation from fourteen to three alternatives.

◦ **Financing Options Subcommittee**

The Financing Options Subcommittee has considered issues related to the identification of potential project funding sources and techniques, such as voluntary private sector participation, legislated private involvement, and the creative leveraging of public funds. Members reviewed an extensive range of possible approaches and their viability at the conceptual level. The subcommittee also considered the potential financial impacts and benefits of phased project implementation.

◦ **Environmental Justice Subcommittee**

The Environmental Justice Subcommittee has been charged with examining questions of potential disproportionate impacts on minority and low-income populations. Environmental justice is a category of impact analysis established by federal Executive Order 12898, signed into law February 11, 1994. The Order addresses a range of interrelated concerns that are "...intended to promote nondiscrimination in federal programs substantially affecting human health and the environment, and to provide minority communities and low-income communities with access to public information on, and an opportunity for public participation in, matters related to human health or the environment." At the state level, the Commonwealth of Massachusetts Executive Office of Environmental Affairs has issued a draft policy on Environmental Justice and was in the process of adopting criteria by which that policy will be implemented at the time this MIS Final Report was prepared.

1.3.2.4 Agency Participation and Coordination

Government agencies at the federal, state, and municipal levels participated extensively in Urban Ring MIS activities. The MBTA initiated a proactive approach to agency communication with a kickoff coordination meeting on January 29, 1997, at the very beginning of the MIS process.

The multi-jurisdictional nature of the Urban Ring (six municipalities, as well as regional planning agencies are involved) required extensive outreach and information sharing efforts on the part of the MBTA and the Urban Ring project team to insure adequate agency participation. To achieve this goal, the major federal and state agencies as well as local municipalities have been included in the Working Committee structure and meetings throughout the MIS study process. In addition, several meetings have been scheduled to coordinate certain aspects of the project as they arise.

The following sections list the categories of meetings and activities with agencies at the federal, state, and municipal levels. Additional documentation on the agency and public participation process is contained in a separate technical memo.

◦ **Federal Agency Coordination**

Federal agencies with interest or potential jurisdiction over the types of transportation improvements considered by the Urban Ring MIS were invited to a project coordination meeting at the beginning of the study and included on the mailing list for project update information. The MBTA met with members of the Federal Transit Administration on a regular basis to discuss program issues and project status.

° **State and Regional Agency Coordination**

The MBTA met throughout the MIS process with representatives of a variety of State and Regional agencies and authorities for routine project status reports and to resolve site specific interface issues between their facilities and/or services and the Urban Ring.

° **Municipal Agency Coordination**

MBTA planning staff and members of the Consultant Team met often and on an ongoing basis with counterparts in municipal government agencies for the six Compact communities. Municipal agencies played a critical role in guiding the Urban Ring MIS, as agency representatives of the five communities are members of the Steering Committee. In addition, the staff of municipal agencies attended workshops, public meetings, working committee meetings, and subcommittee meetings.

Following is a list of the municipal agencies with which MBTA Planning staff and the Consultant Team maintained regular communication:

Boston Community Development Department	Cambridge Transportation Department
Boston Redevelopment Authority	Chelsea Office of Community Development
Boston Transportation Department	Chelsea Department of Public Works
Brookline Planning Department	Everett Community Development Department
Brookline Transportation Department	Everett Transportation Department
Cambridge Planning Department	Somerville Community Development Department
Cambridge Community Development Department	Somerville Transportation Department

1.3.2.5 Coordination with Major Institutions

The MBTA and Consultant Team met frequently with representatives of major academic, medical, and cultural institutions in the project corridor. Several of these institutions acted as hosts for Urban Ring planning workshops and public meetings. Following are the major institutions and organizations with which the MBTA coordinated Urban Ring planning activities.

Boston University	Forest City Development (associated with M.I.T.)
Boston University Medical Center	Medical Academic and Scientific Community
Bunker Hill Community College	Organization, Inc. (MASCO)
Emmanuel College	Roxbury Community College
Harvard University	Simmons College
Harvard University Medical School	University of Massachusetts - Boston
Massachusetts Institute of Technology	Various Transportation Management Associations
Northeastern University	

1.3.3 Public Meetings and Workshops

The MBTA has held or participated in nearly 100 public meetings, workshops, and community meetings as part of the Urban Ring MIS. Detailed information on public and agency participation activities is contained in the separate public participation technical memo.

For the Urban Ring MIS, the MBTA has held or participated in five types of meetings:

- Meetings of the Working Committee, Steering Committee, and subcommittees;
- Workshops;
- General public meetings;
- Presentations to community and business groups;
- Other outreach.

As part of the outreach effort for meetings, the Public Participation Subcommittee in 1997 developed an Urban Ring mailing list database of approximately 2,200 people, including residents of the project corridor and the region, government agency representatives, elected officials, representatives of major institutions in the project corridor, and others. The people on this list received notices of project activities, public meeting announcements, and copies of the Urban Ring brochure. The MBTA, Consultant Team, and Public Participation Subcommittee updated this database throughout the MIS process.

1.3.3.1 Working Committee, Steering Committee, and Subcommittee Meetings

Meetings under the auspices of the Working Committee were key components of the public and agency participation effort for the Urban Ring MIS. These gatherings included the meetings of the Working Committee itself, Steering Committee meetings, and the meetings of the individual subcommittees. These meetings are described in the following sections.

◦ **Working Committee Meetings**

In addition to the six public workshops, the Working Committee held additional meetings to review alternatives and revised technical information. These meetings are list below; minutes are included in the public participation technical memo.

December 16, 1998	Presentation of Preliminary Hybrid Alternatives	State Transportation Building, 10 Park Plaza, Boston
August, 2000	Alternatives Presentation	State Transportation Building, 10 Park Plaza, Boston
June 4, 2001 5 to 9 PM	Review and Discussion of MIS Findings	State Transportation Building, 10 Park Plaza, Boston

◦ **Steering Committee Meetings**

The Steering Committee met approximately every one to two months throughout the MIS process. These meetings were held during the periods between meetings of the full Working Committee to continue the conduct of business and to present and shape materials for upcoming workshops, public meetings, and other events. Steering Committee meeting dates and minutes are included in the public participation technical memo.

◦ **Subcommittee Meetings**

The five subcommittees met with varying frequencies during different periods of the MIS, depending the nature of the committee's work. These meetings allowed committee members to explore in greater depth many issues and concerns that were too specific or involved for the entire Working Committee. Subcommittee meeting dates and minutes are documented in the public participation technical memo.

1.3.3.2 Public Meetings

Public meetings for the Urban Ring took place in two contexts: 1) as general public meetings held by the MBTA at locations in the project corridor at which the Urban Ring was the sole topic, and 2) as presentations made by MBTA and project team members to community groups and civic organizations at their regular meetings.

The Public Participation Subcommittee worked with the Consultant Team to ensure that public meetings, workshops, and presentation materials were accessible for handicapped and non-English speaking people. All meeting notices and advance materials advised that materials would be made available in an alternate format if requested. Meeting notices also advised persons requiring translation of the materials, oral translation at the meeting itself, and/or physical access requirements to make requests for such services at a reasonable interval prior to the meeting.

Public outreach presentations included a slide show or PowerPoint presentation describing the Urban Ring and recent developments in the MIS process. As the MIS proceeded, these presentations were updated to include information on the development and selection of alternatives. Meeting attendees also received handouts maps, brochures, and other written materials.

◦ Workshops

One of the core elements of the MIS public and agency participation plan was a series of six public workshops held under the auspices of the Working Committee. These are listed below.

Workshop	Topic	Date	Location
1	Baseline Conditions, Project Goals and Objectives, and Evaluation Criteria	April 24, 1997 12 noon to 5 p.m.	State Transportation Building, 10 Park Plaza, Boston
2	Activity Center Alternatives	May 21, 1997 9 a.m. to 5 p.m.	Northeastern University, Eagan Research Center, Boston
3	Alternatives Screening and Synthesis	July 15, 1997 12 noon to 5 p.m.	Northeastern University, Eagan Research Center, Boston
4	Detailed Alternatives	Sept. 15, 1997 12 noon to 5 p.m.	State Transportation Building, 10 Park Plaza, Boston
5	Alternatives Evaluation	March 30, 1998 12 noon to 5 p.m.	State Transportation Building, 10 Park Plaza, Boston
6	Alternatives Evaluation	January 21, 1999 12 noon to 5 p.m.	Northeastern University, Eagan Research Center, Boston

These workshops were highly focused sessions in which the Consultant Team presented technical work and participants offered ideas and comments. The interactive workshop process provided free-flowing communication and consistent information among all participants. Workshop summaries, lists of attendees, minutes, and other detailed documentation are contained in the Public Participation Technical Memo.

◦ General Public Meetings

The MBTA held 13 large general public meetings to inform members of the general public about Urban Ring MIS activities and solicit public comment. A list of these meetings is provided below; meeting summaries, minutes, and lists of attendees are provided in the public participation technical memo.

Date & Time	Communities	Location	Attendees
January 29, 1997 3 to 4:30 p.m.	Metro Region (MIS Coordination Meeting)	State Transportation Building, 10 Park Plaza, Boston	35
June 11, 1997 7:30-10 p.m.	Boston/Brookline/ Roxbury/ Dorchester	Wentworth Institute of Technology, 550 Parker Street, Boston	57
June 18, 1997 7:30-10 p.m.	Cambridge/Somerville/ Charlestown	Holiday Inn, 30 Washington Street, Somerville	75
June 19, 1997 7:30-9:30 p.m.	Everett/Chelsea/East Boston	Chelsea City Hall, 500 Broadway, Chelsea	25
Sept. 17, 1997 7:30-10 p.m.	Cambridge/Somerville/ Charlestown	Massachusetts Institute of Technology, Whittaker School of Health, 45 Carleton Street, Cambridge	118
May 1, 2000 12 noon–2 p.m.	Metro Region	State Transportation Building, 10 Park Plaza, Boston	45
May 2, 2000 6:30-8:30 p.m.	Boston/Brookline	Harvard School of Public Health, Kresge Building, 677 Huntington Avenue, Boston	20
May 17, 2000 6:30–8:30 p.m.	Boston/Roxbury/ Dorchester	20 Hampden Street, Boston	20
May 23, 2000 6:30–8:30 p.m.	East Boston/Chelsea/ Everett	Chelsea City Hall, 500 Broadway, Chelsea	15
May 24, 2000 6:30–10 p.m.	Cambridge/Somerville/ Charlestown	Massachusetts Institute of Technology, Whittaker School of Health, 45 Carleton Street, Cambridge	50
July 17, 2001 6:30-8:30 p.m.	Chelsea/Everett/ Somerville	Chelsea City Hall, 500 Broadway, 3 rd Floor, Chelsea	Approx. 12
July 18, 2001 6:30-8:30 p.m.	Boston/Brookline	Northeastern University, Eagan Center, Raytheon Ampitheater, 120 Forsyth Street, Boston	Approx. 100
July 19, 2001 6:30-8:30 p.m.	Cambridge/Somerville	MIT, Building E-25, Room 111, 25 Carleton Street, Cambridge	Approx. 75

This series of meetings was geared to provide updates on project progress to, and solicit comments from, a wider public audience than the “core” group regularly involved in activities of the Working Committee and its subcommittees. General public meetings were held in the evening for the convenience of people who, due to their work schedules, could not attend other Urban Ring meetings during regular business hours. Meeting locations were selected to provide accessibility to the people who live and work near the possible alignments being studied. However, residents of all communities and the Greater Metro region were advised that they were welcome to attend any public meeting.

Approximately three weeks before each meeting, the MBTA mailed notices to the approximately 2,500 people on the Urban Ring mailing list. In addition, the consultant team promoted the meetings widely among participating agencies, community groups, and the general public.

The agenda of the general public meetings typically included a summary of the MIS process to date, a review of Working Committee activities, a summary presentation of any results to date, and a question and answer period. Topics included project goals and objectives, alignments, mode choices, and preferred investment strategies. All comments from the public and responses from the MBTA and project team were recorded, and participants were offered copies of the meeting minutes. The MBTA provided meeting summaries to members of the Public Participation Subcommittee and Working Committee.

◦ **Presentations to Community and Business Organizations**

Since the start of the Urban Ring MIS in January 1997, the MBTA has given more than 50 presentations and briefings about the project to business groups, chambers of commerce, neighborhood associations and other community-based organizations. The comments received from these organizations were essential to the shaping of alternatives. A list of these groups follows; many groups received two or more presentations.

Allston Civic Association	Everett Kiwanis
American Planning Association	Everett Rotary
Audubon Neighborhood Association	Everett Lions Club
Boston Architectural Center	Fenway Alliance
Boston League of Women Voters	Fenway Civic Association
Boston Society of Architects -- Build Boston Exposition and Civic Initiative Charrette	Fenway Community Development Council
Boston Society of Civil Engineers Membership Meeting and Bert Berger Annual Seminar	Finance Subcommittee Corridor Tour
Boston University Medical Center Transportation Demand Group	Greater Boston Chamber of Commerce Development and Transportation Committee
Boston University School of Management and Facilities Planning	Greater Boston Real Estate Board of Directors
Cambridge Chamber of Commerce	MASCO
Cambridgeport Area Community	Massachusetts Institute of Technology "Big Plans" class
Charlestown Neighborhood Council	Metropolitan Area Planning Commission
Chelsea Rotary Club	Mission Hill Community Alliance
Chelsea Chamber of Commerce	Mission Hill/Boston 400
Chelsea Transportation Group	MoveMass
Circumferential Transportation Employers Coalition	Newmarket Business Association
Columbia Point Residents Association	Roxbury Neighborhood Council
Cottage Farm Neighborhood Association (Brookline)	Rutherford Avenue Corridor Study Committee
Dorchester/Roxbury Urban Ring Coalition	Somerville Chamber of Commerce
Dudley Square Main Street	Somerville Mayor's Office and Community Development Department
Dudley Street Neighborhood Initiative	Somerville Union Square Neighborhood
East Boston Land Use Council	Telecom City Commissioners
East Cambridge Planning Team	University Associates
Everett Chamber of Commerce	Women's Transportation Seminar
Everett City Engineering and Community Development Departments	

◦ **Other Outreach**

The MBTA and Urban Ring consultant team provided an informational exhibit for legislators and the public on February 2, 1999, at the Massachusetts State House in the Hall of Flags. MBTA and project staff also provided a briefing on the project for members of the Joint Committee on Transportation.

In addition, faculty at the Massachusetts Institute of Technology's School of Transportation Studies, Harvard University's Graduate School of Design, the Boston Architectural Center, Northeastern University and University of Massachusetts Boston have used the Urban Ring as a teaching topic. The Boston Globe held a visionary conference on the future of the region at which the Urban Ring was a key feature, and the Boston Society of Architects has featured the Urban Ring at multiple forums and charrettes. The MBTA and Consultant Team have supplied information and handouts, and given presentations to classes and individual students as part of the outreach effort.

1.3.4 Outreach Materials Produced and Distributed

The project team produced a wide variety of materials for public information including: presentation boards, information mailings, meetings handouts, slide shows, PowerPoint presentations, brochures, and maps. The MBTA website also has posted the second Urban Ring brochure for increased public access.

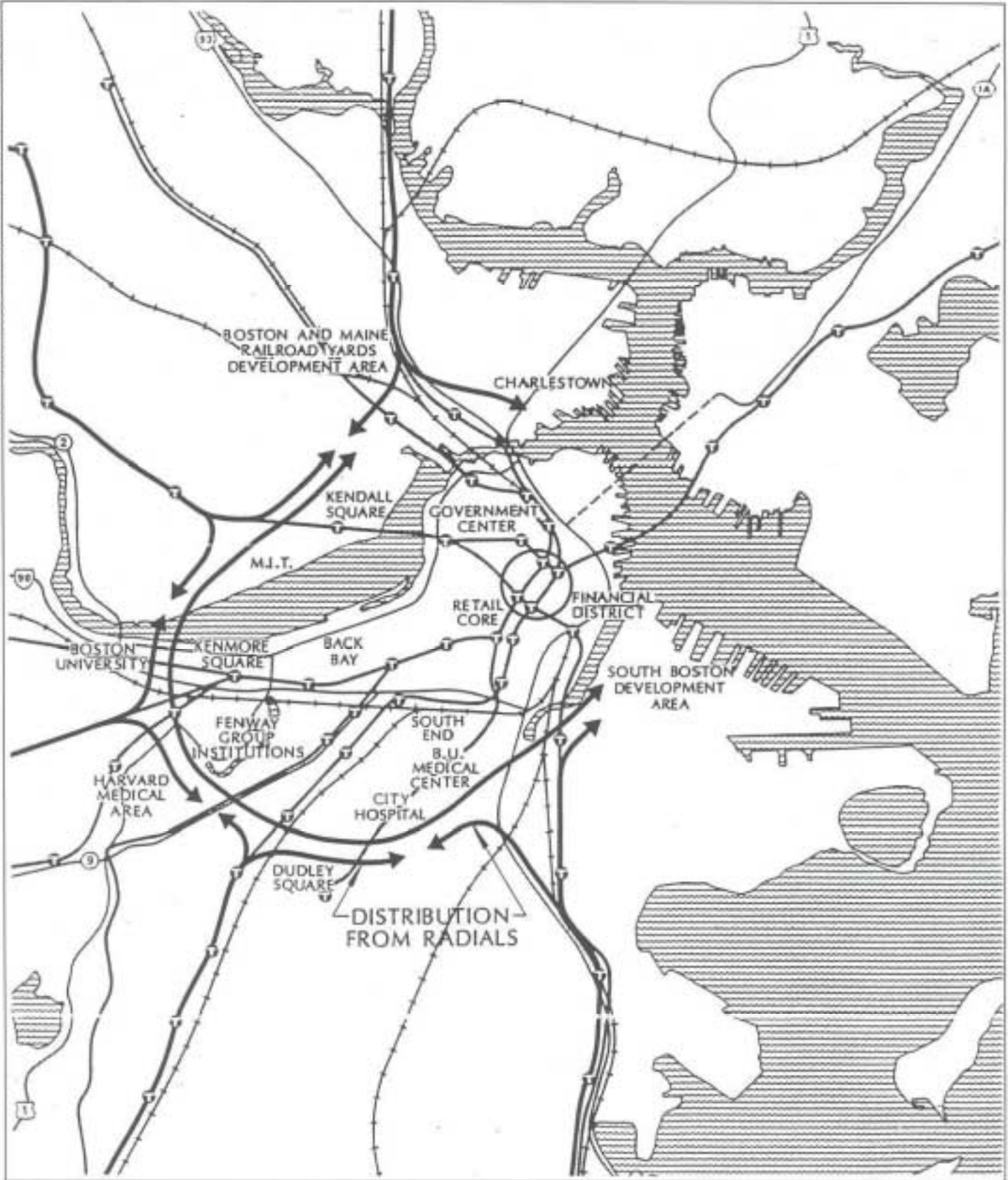
1.3.5 Summary of Comments

The MBTA's Urban Ring MIS has generated hundreds of comments in a variety of meetings, telephone calls, and correspondence. The overwhelming majority of comments received express support for the Urban Ring and encourage the MBTA to make the most of project-related opportunities to improve the overall regional transportation system. The public participation technical memo contains a summary of comments received relative to the Urban Ring project.

1.3.6 Media Coverage

The public participation program also generated favorable coverage of the Urban Ring MIS in print and electronic media. The public participation technical memo documents the media coverage of the project.

MBTA CONTRACT NO. 225992 FILE L.U. URBAN TRANSIT REPORTING POINTS (LNU)



1972 Boston Transportation Planning Review

Circumferential Transit Concept Plan

TRANSIT  TRAN

Figure 1-1

Not to Scale





META CONTRACT NO. XPR122 FILE 1.1 URBAN TRANS REPORT TRANSMITTED.DWG



ALT. 3C
CORE
LRT



ALT. 3D
JFK/UMASS
CORE
LRT



ALT. 3E
JFK/UMASS
TO AIRPORT
VIA
COMMUNITY
COLLEGE



ALT. 3F
JFK/UMASS
TO AIRPORT
VIA
GRAND
JUNCTION



ALT. 5D
MINI
METRO
CORE
ALIGNMENT



ALT. 6
GUIDED
BUS

TAMS Consultants, Inc.



1989 Circumferential Transit Feasibility Study

Long Range Alternatives

EARTH SYSTEM

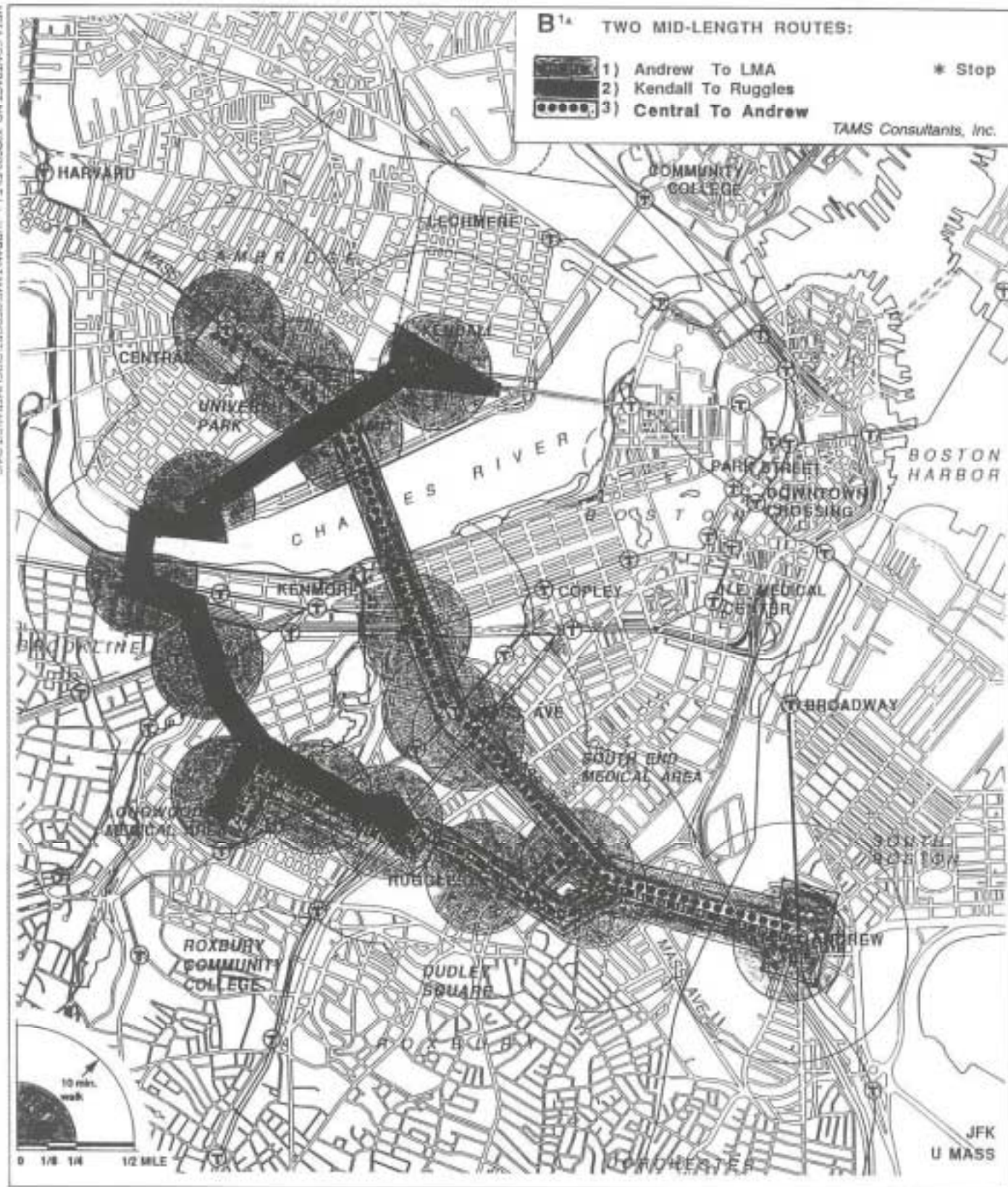


Figure 1-2

Not to Scale



MFTA CONTRACT NO. X09-92 FILE L-1 URBAN TAMS REPORT CIRCUMFERENTIAL DMS



1993 Circumferential Transit Mid-Term Study Recommendation Network Limited-Stop Routes

TAMS TECH

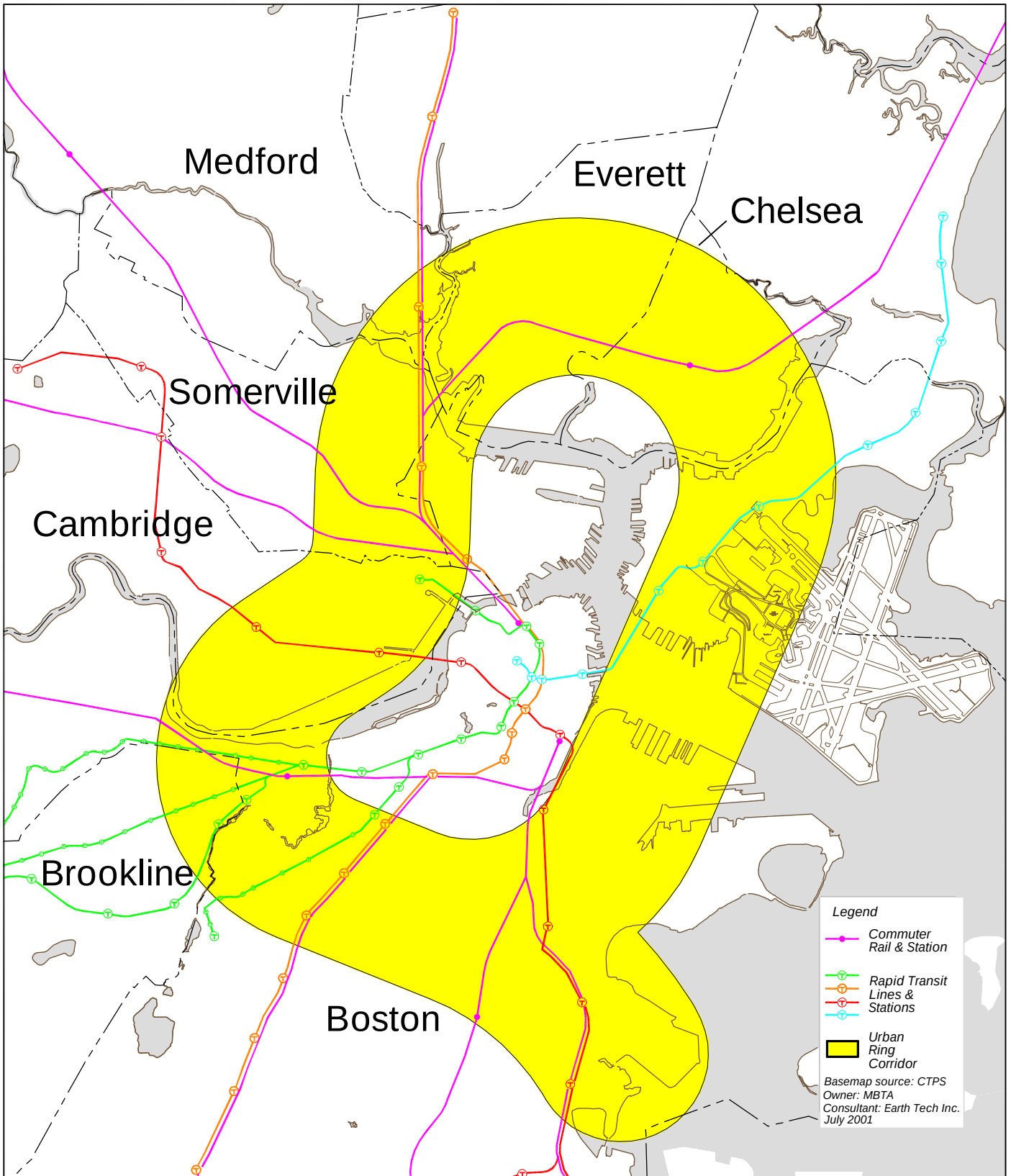
Figure 1-3



Not to Scale



MBTA CONTRACT NO. X2PS92 FILE 1.1...URBANITAMSIREPORTSTUDYAREA.DWG



Urban Ring Corridor

Study Area

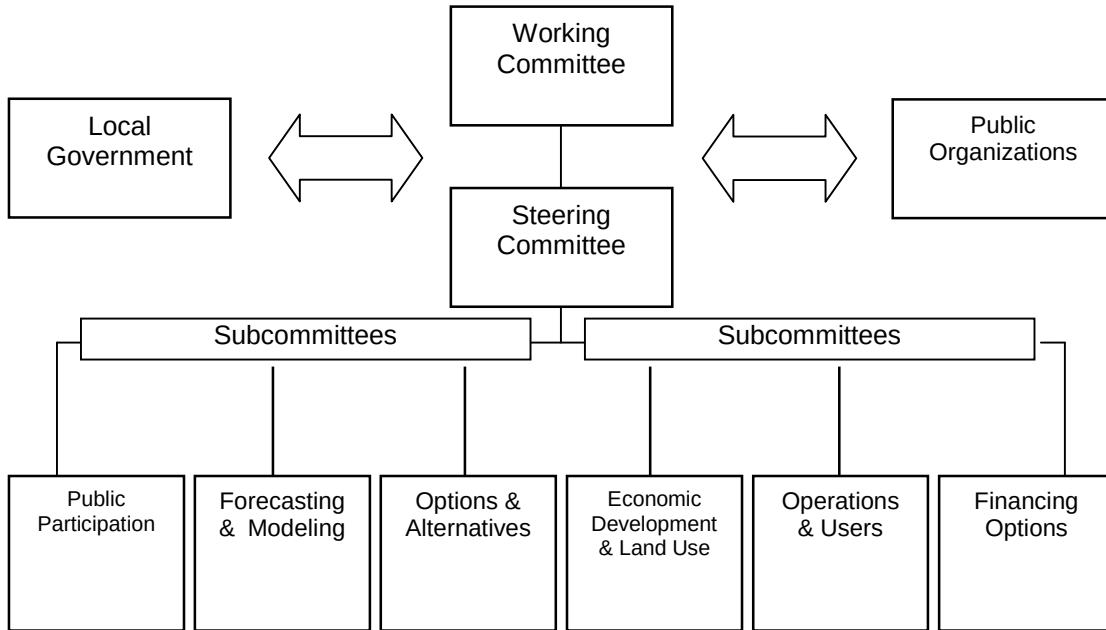
Figure 1-4

JULY 2001



Figure 1-5

Urban Ring Committee Structure



Chapter 2

CORRIDOR CHARACTERISTICS

2.0 CORRIDOR CHARACTERISTICS

This chapter provides a summary overview of the existing man-made and natural environments of the Urban Ring Corridor, as well as projected future conditions in the absence of any Corridor transportation improvements. These baseline Corridor characteristics were identified and documented at either the regional or local level, depending upon the data needs of the evaluation tasks that followed.

Transportation system information, travel patterns and air quality data that are regional in scope were evaluated relative to the full Urban Ring Corridor. Land use and economic baseline information, Corridor subareas and neighborhoods, noise and vibration, ecosystems, water resources, historical and archeological resources, parklands, and hazardous materials are areas of potential concern based on proximity to physical elements of project. Therefore, data was collected for those characteristics in areas of the six Urban Ring Regional Planning Compact (the Compact) communities that could be directly impacted by the transportation alternatives under consideration.

A separate report has been prepared by the Compact detailing the economic development and land use opportunities, and vision for the Corridor from the perspective of the member cities and towns.

2.1 Demographics

This section summarizes existing baseline and forecast year 2025 employment, development and socioeconomic characteristics within the Corridor. The demographic and land use factors within the Corridor are examined in greater detail within Chapter 6. The key demographic data presented in this chapter are listed below:

- Employment
- Population
- Mean household income
- Vehicles per household
- Minority Population

2.1.1 Employment

The number of jobs within the Boston region has grown dramatically while population has grown relatively slowly. This increase in employment, without a corresponding population increase, has resulted from the following patterns¹:

- The percentage of residents living in the region who work has increased as more women and teenagers have joined the work force;
- The number of people with more than one job has increased;
- The number of people commuting from outside the region to jobs within the region has increased.

The resultant effect of these factors is additional stress on the transportation network during peak hours.

The Corridor contained approximately 14 percent of the total jobs in the region in 1995, a percentage that is expected to accelerate through the design year 2025. The data in Table 2-1 shows that between 1995 and 2025, the jobs in the Corridor are projected to increase by nearly 52 percent to 360,000 jobs, a rate

¹ Boston MPO Transportation Plan 2000-2025, CTPS.

almost twice than the rate of job growth in the region as a whole.

2.1.2 Population

The population in the Boston Region has remained constant over the last four decades.² However, the distribution of people has shifted dramatically away from the urban core to the suburbs resulting in what is referred to as "suburban sprawl". In the 1990's, people began moving back into the urban areas including the City of Boston, although small compared with the out-migration of the previous decades. MAPC projects that population will increase by approximately 7 percent over the next 25 years, and there would be little change in the distribution of current population patterns.

Table 2-1 shows the population within the Corridor and the region. The 1995 population represented 8.9 percent of the total regional population. Population within the Corridor is projected to increase about 16 percent between 1995 and the design year 2025 compared to only roughly 7 percent population growth projected for the region as a whole. Population growth has been modest relative to job growth in the Corridor and this trend is expected to continue.

2.1.3 Households and Household Income

While population has remained constant over the last several decades in the Boston Region, the number of households has increased by approximately 19 percent between 1970 and 1990.³ This pattern has occurred due to the following factors:⁴

- Increase in number of people that are financially able to purchase a home and live apart from a larger family unit;
- Increase in Neo-Traditional Households, e.g. single parents;
- Households are less likely to consist of more than two generations as was prevalent in the past.

Households within the Corridor are projected to increase by approximately 21 percent between 1995 and 2025. The increase in households will increase the demand for transportation services. With fewer non-working spouses at home, more automobile trips occur during peak commute periods.⁵

Low household incomes in an urban area often indicate transit dependency. Approximately 21 percent of households within the Corridor were reported to be below the poverty level in 1990.

2.1.4 Automobile Ownership

Automobile ownership has been rising in the region, including Boston and Cambridge where non-automobile opportunities are good.⁶ Automobile ownership is another important index suggesting where additional transit investments may be necessary. Typically, households without automobiles are dependent upon public transportation for access to work and other destinations. Census data shows that automobile ownership is very low for households located in the Corridor compared to the region. As of 1990, the average automobile ownership rate for the Corridor was 0.80 automobiles per household, which is 42 percent lower than the 1990 regional average of 1.37. In 1990, approximately 43 percent of households within the Corridor had no vehicle. Low auto ownership rates in the Corridor are an indicator of the propensity to use transit.

^{2,3,4,5,6} Boston MPO Transportation Plan 2000-2025, CTPS

2.1.5 Minority Population

Minority population is another important index suggesting where additional transit investments may be necessary. The 1990 census data shows that minorities represent approximately 45 percent of the population within the Corridor. Figure 2-1 compares the Corridor to the region as a whole for minority population, as well as low income households and households without automobiles.

2.2 Transportation

The purpose and need for the project described in Chapter 1 was identified and defined through analyses and documentation of the baseline conditions of the transportation system in the Corridor today and in the future. A quantitative analysis of the travel patterns in the Corridor and region as a whole was conducted early in the study and was documented in a separate technical memo. The summary level volumes of regional and Corridor trips was updated with the latest CTPS data in 2001 which is summarized below showing the Corridor accounts for a large percentage of total trips in the region. Also examined in detail was the existing and future transportation network serving the Corridor. As described below, the analysis shows that the current lack of adequate transit service and facilities in the Corridor will continue into the future in the absence of the Urban Ring.

Also described are many of the other transportation related characteristics of the Corridor, such as rights-of-way, plans and policies, that provide an opportunity to implement the types of improvements identified in later Chapters of this report.

2.2.1 Travel Patterns

This section summarizes the travel market characteristics in the Corridor. Future conditions are discussed relative to conditions in the forecast year for each of the three phases of the Urban Ring: Phase 1 - 2003, Phase 2 - 2010, Phase 3 - 2025. Analysis of the existing and anticipated travel markets is a critical component of:

- Identifying key transportation linkages in the Corridor;
- Understanding the mobility and accessibility problems of the Corridor;
- Developing transportation improvement strategies able to meet projected demand.

2.2.1.1 Travel Market Analysis Approach

Two types of analyses were conducted to understand the transportation markets in the Urban Ring Corridor. The first analysis examined the trip demand associated with 17 Traffic Zone Groupings that comprise the Corridor⁷. This demand is expressed as average daily person trips⁸ to and from each Urban Ring traffic zone grouping and other zone groupings within the Corridor, the Boston Inner Core and six radial transportation corridors external to the Corridor. By understanding the magnitude of Corridor-related origins and destinations, the travel patterns, and potential transportation, problems and solutions for the Corridor are clarified. Details of the 1997 travel market analysis are contained in the referenced technical memo. The demand analysis was updated on a Corridor basis to include South Boston and the updated aggregate projections are contained in paragraph 2.2.1.2 below.

⁷ *Travel Market Analysis*, Cambridge Systematics, Inc., May 7, 1997. The travel market analysis at that time was based on the CTPS 787 zone system and did not include South Boston, for which data was not available. Therefore, the zone boundaries and aggregations differ slightly from those used for the demographic analysis which used the newer CTPS 986 zone system. Refer to Appendix A for definition of traffic analysis zones.

⁸ A person trip is independent of mode of travel or the number of persons traveling together in a vehicle. For example, two people traveling together in the same automobile between an origin and destination are counted as two person trips, although only one automobile trip is made. A person trip is also independent of trip purpose; it can either be home-based (e.g., commuter) or non-home based. Finally, person trips represent motorized travel only; no pure walk trips from an origin to a destination are counted.

The second analysis focused on the supply of transit services to and from key destinations in the Corridor. This analysis shows how well available services meet the trip demands to and from the Corridor by examining transit travel time, the number of transfers needed to reach a destination and the speed of travel. Results of the supply analysis underscore the purpose and need for transportation improvements presented as part of Chapter 1.

◦ **Transportation Networks**

Four transportation networks were utilized by CTPS to conduct the demand analysis. The first is the base year (1995) network, which assumes existing conditions throughout the Boston metropolitan region⁹, including the Corridor. The remaining three networks represent conditions anticipated in years 2003, 2010, and 2025, corresponding to Phases 1, 2, and 3 of the Urban Ring.

The future conditions contain assumptions about regional growth trends that are reflected in the current Long-Range Metropolitan Planning Organization (MPO) Transportation Plan for the Boston metropolitan region. The projects assumed in the MPO 2025 Build Scenario, which did not include the Urban Ring, were estimated to increase transit system link trips in the region by over 30,000 per day compared to the MPO's No-Build Scenario.¹⁰ The transit mode share in the region for the MPO's 2025 Build Scenario is projected to increase by 0.2 percent over the MPO's No-Build Scenario.¹⁰

2.2.1.2 Demand Analysis Results

◦ **Base Year (1995)**

Approximately 1,648,000 daily person trips were made to and from the Corridor in 1995. This represents 13.8 percent of all trips made in metropolitan Boston. Most of these daily trips have either an origin or a destination outside of the Corridor.

◦ **Year 2003**

For the years 2003, 2010, and 2025, daily trip demand patterns for the Corridor were examined using projections of land use, employment and population for the Boston metropolitan region contained within the CTPS model set. Approximately 1,754,000 daily person trips are forecast to and from the Corridor in 2003. This represents growth of over 6 percent compared to 1995 trip volumes. Daily person trips made to and from the Corridor will account for a slightly lower percentage (13.5%) of total regional trip making in 2003 than in 1995.

◦ **Year 2010**

For 2010, approximately 1,903,000 daily person trips are projected to travel within the Corridor, representing over 14 percent of all trips made in the region. The 2010 daily person trips represent an increase of approximately 8.5 percent over 2003 trip volumes.

◦ **Year 2025**

Over 2 million daily person trips are forecast to and from the Corridor in 2025. This represents an increase of over 8 percent over 2010 trip volumes. Daily person trips made to and from the Corridor represent 8.3 percent of the total regional trips in 2025.

⁹ For this analysis, the region modeled by CTPS encompasses the 164 cities and towns in Eastern Massachusetts. The MPO's Regional Transportation Plan "Build" scenario contains the transit projects shown in Figure 2-6, which at this time does not include the Urban Ring project.

¹⁰ Boston MPO Transportation Plan 2000-2025, CTPS.

2.2.1.3 Supply Analysis Results

The supply analysis was conducted in 1997 using 1990 data. The analysis examined transit paths from a set of selected origins to key destinations in the Corridor. The analysis was intended to assess how well the existing (1990) transit system serves trips to the Corridor from other areas in the region¹¹.

Sample origins were selected from the Boston Inner Core and the six external radial corridors, as well as from within the Corridor. The sample was selected based on the high volume of trips generated from each origin to key destinations in the Corridor each day. In total, transit paths between some 400 origin-destination pairs were examined.

No attempt was made to weight the results of this analysis by trip demand. Rather, the analysis looked at how easily a trip can be made between each origin-destination pair using existing transit services, without consideration of the number of trips that are actually made between each origin and destination. However, because the origins were selected based on their high-trip generation volumes, it can be inferred that demand does exist for transit travel between each origin and destination pair examined. The scope of the analysis covered 17 of the largest activity centers in the Corridor.

For each sample origin, the average number of transfers needed to reach these destinations in the Corridor was calculated. For the analysis, each destination was defined by the single TAZ that best represented the centroid of the area. In addition, the average effective transit travel speed was estimated for these trips. Effective transit travel speed was calculated by dividing the total travel time associated with each trip by the number of miles traveled between the trip's origin and destination¹².

Table 2-2 shows the average number of transfers and effective transit travel speeds in 1990 between the sample origins external to the Corridor and the sample Corridor destinations. Table 2-3 presents the same information for the origins located within the Corridor. For origins external to the Corridor, an average of 1.4 transfers are needed to reach a transit rider's final destination within the Corridor, at an effective average speed of 15.5 miles per hour. This average speed reflects the fact that the largest share of most trips made from external origins to the Corridor occur on commuter rail services which operate at higher average speeds and with fewer stops per mile of operation than either rapid transit or buses. In contrast, for origins within the Corridor, an average of 1.2 transfers is needed, but the average speed of travel is much slower at only 7.8 miles per hour. This slow speed of travel is in part reflective of the need for transit trips within the Corridor to travel relatively greater distances via indirect routes between trip origins and destinations.

The analysis showed that more than one transfer is needed over 56 percent of the time to travel on transit between the sample external origins to the Corridor. Only 9 percent of the transit travelers to and within the Corridor do not need to make a transfer to reach their destinations, and 3 percent must make three transfers. The issue of multiple transfers is of concern since research has indicated that transit riders perceive "out-of-vehicle" time more onerously than the time spent traveling in a transit vehicle. Out of vehicle time includes the time it takes to walk to a transit station or stop, the time spent waiting for a transit vehicle, and the time it takes to transfer between transit services. As a result, the more transfers that are required, the worse the rider's perception will be of the transit services used.

As a point of comparison, CTPS has calculated that the average number of transfers per transit trip for the overall Boston metropolitan region is 0.71. Thus, the average number of transfers required to and from the Corridor is almost twice the regional average.

¹¹ Only travel by transit made (bus, rapid transit, commuter rail) was examined as part of the supply analysis; no analysis of automobile travel was performed. Refer to Appendix E for results of the transportation supply analysis, and the summary and conclusions.

¹² Travel distance is based on the average walking or driving distance to access the nearest available transit mode in the vicinity of the trip origin, transit travel distance and walking distance from the nearest transit drop-off point to final destination. Travel time includes transfers and typical wait times.

In addition, most transit paths from external locations to destinations in the Corridor involve traveling into the Boston Inner Core. The same is true for travelers whose trips originate in the Corridor. They, too, must first travel into the Boston Inner Core before reaching destinations elsewhere in the Corridor. In this latter case, there may be only a relatively short distance between an origin and a destination within the Corridor, but the only available transit access involves an out-of-the-way and time-consuming trip.

As noted above, transit travel speed to destinations within the Corridor is quite slow, averaging 15.5 miles per hour for trips originating outside the Corridor and 7.8 miles per hour for trips originating within the Corridor. As a basis of comparison, CTPS has calculated an average regional automobile travel speed of 31.5 miles per hour. These transit travel speeds are due, in large part, to the numerous transfers that must be made, as well as circuitous routes.

2.2.2 Existing Roadway Network

Early in the MIS, an inventory was prepared identifying key roadways that may impact the network in and around the Corridor. The review relies on information obtained primarily from Mobility in the Boston Region, A Report of the Congestion Management System¹³ and Transportation Improvement Program and Air Quality Conformity Determination, Fiscal Years 1997-1999¹⁴.

The Corridor is served by an extensive network of arterial roadways and limited access highways, as illustrated in Figure 2-2. Each of the major facilities cross the Corridor including the Southeast Expressway (Interstate 93), the Massachusetts Turnpike (Interstate 90), Storrow Drive, Memorial Drive, Route 28, Route 99, the Northwest Expressway (Interstate 93) to Route 1A and the Ted Williams Tunnel (Interstate 90). A number of major crosstown arterial roadways, such as Route 2A and Route 16, also cross the Corridor. However, none of these roadway facilities connect more than a few of the more than 20 Urban Ring activity centers. Additionally, except for the Ted Williams Tunnel, the Urban Ring is served by no crosstown limited access facility. In many areas of the Corridor only local and collector streets are available for crosstown trips. A detailed description of the highways and other roadways in the Corridor is contained in the technical memo documenting baseline conditions.

2.2.3 Future Roadway Network

The roadway network serving the Corridor will see little if any change by the 2025 design year since no major new roadways or expansion of existing facilities are being contemplated in the Corridor. While there are plans for minor improvements, none of these projects will have a major impact on the overall network. In addition, two major highway projects are under construction in the region, the Central Artery and the Third Harbor Tunnel extension to the Massachusetts Turnpike. These projects are expected to result in significant improvements to the roadway network serving the Boston Core, as well as travel through Downtown Boston. Certain elements of the Central Artery/Tunnel are expected to directly benefit the Bus Rapid Transit (BRT) elements of the Urban Ring, particularly in East Boston and South Boston due to the Ted Williams Tunnel and associated roadway interchanges. Additionally, the overall Central Artery project is likely to have additional indirect positive impacts on Urban Ring roadway network conditions.

2.2.4 Existing Public Transportation Network

The MBTA operates an extensive public transportation network of bus, radial transit, commuter rail and water ferry services. The network is comprised of local and express buses, three rapid transit lines, a light rail line with four branches, twelve commuter rail lines and commuter boats. Figure 2-3 illustrates the existing public transportation network serving the Corridor. Ridership on the entire network of MBTA fixed

¹³ Central Transportation Planning Staff, November 1996

¹⁴ Boston Metropolitan Planning Organization, August 1996

routes was nearly 1.2 million daily unlinked trips in 1995, the most recent year for which comprehensive ridership data is currently available.

The bus system has an extensive network of radial routes that feed the Corridor rail stations from areas to the north, west and south. Additionally, the bus system has a number of local bus services that originate in the Corridor and connect to the Boston Core. The radial bus system includes express routes that cross, but do not stop within, the Corridor. The existing bus system also includes several crosstown routes that operate in mixed traffic through portions of the Corridor. Many of these routes link a number of the Corridor's activity centers and experience some of the highest ridership levels of all MBTA bus routes.

All of the rapid transit and light rail lines cross the Urban Ring and have stations in many of the Corridor's activity centers. The commuter rail system also has a radial configuration, oriented primarily to connecting the Boston Core with suburbs beyond the Urban Ring. However, currently three of the commuter rail lines have no station stops where they cross the Corridor, and others lack full service.

2.2.4.1 Bus System

The MBTA bus routes consist of radial services to downtown Boston and a number of other centers in the region, feeder routes to both the rapid transit and commuter rail system, and a large number of crosstown routes. Four of the bus routes are trackless-trolleys powered by electricity from overhead catenary; these routes serve portions of Cambridge, Watertown and Belmont.

- **Local Bus Network**

The MBTA operates an extensive network of local bus routes that serve most of the activity centers in the Corridor. These routes include a number of crosstown services that connect areas along the Urban Ring, as well as many radial routes which connect Corridor areas to both the Boston Core and to locations to the north, west and south of the Corridor. Tables 2-4 and 2-5 provide a listing of the existing bus routes in the Corridor and are classified as either radial or crosstown routes. In addition, the tables present average weekday ridership statistics for each of the routes and for MBTA's total bus network. From these tables, it can be seen that the Corridor is served by a total of 62 routes. Based on the most recent available data (between 1997 and 2000), these total routes accounted for 233,573 daily riders, or 62 percent of the MBTA's total bus network ridership of 377,000.

In addition to the radial routes, 28 routes that serve a predominantly crosstown function also serve the Corridor. These routes provide single route connections among a number of the Corridor's activity centers and carry a total of approximately 92,859 daily riders. Table 2-6 provides additional information on recent ridership growth on the three relatively new circumferential routes. From this table, it can be seen that ridership has doubled on the CT2 and CT3 routes over the several years, and has increased by approximately 40 percent on the CT1 route. In early 1999 the CT3 route was extended from Andrew Station to Logan Airport via the South Boston Haul Road and Ted Williams Tunnel. In 2000 the CT2 route was extended from Kendall/MIT to Sullivan Square via Union Square.

- **Express Bus Network**

Approximately 10 percent of the MBTA bus routes provide express services. These express routes provide direct or limited-stop service from Newton, Watertown, Waltham, Medford, Burlington, Woburn, Lynn, Marblehead, Salem, Saugus and Brighton to downtown stops at Haymarket, the Financial District and Park Square. One bus also terminates at Copley Square. No MBTA express buses currently serve the Corridor.

In addition to the MBTA, Massport operates three express bus routes that serve the Logan Airport portion of the Corridor. These Logan Express routes originate in Braintree, Framingham and Woburn, where airport passengers and employees can park or be dropped off before riding the bus directly to airport terminals. Service operates from early in the morning to late at night. In 1994, 1,800 passengers rode the

system. The Braintree service carries 47 percent of the system's total passengers, the Framingham service carries 40 percent and the Woburn service carries the remaining 13 percent.

2.2.4.2 Rapid Transit System

The MBTA rapid transit system is comprised of four lines with a total of 125 stations and 64 route miles. The Orange, Red and Blue Lines are completely grade-separated, predominantly third-rail systems. The Green Line is a light rail system that operates in a combination of grade-separated right-of-way, at-grade reservations and along city streets. All of these lines are radial, focus on downtown Boston and cross the Corridor. Except for the Red Line and Blue Line, all of the lines intersect at major transfer points in the Downtown.

In 1997, the most recent year for which complete data exist, approximately 642,000 unlinked transit trips were made on the rapid rail and light rail system on an average weekday, with approximately 131,000 transit trips in the Corridor. Figure 2-4 illustrates total boardings by station and line for the rapid transit and light rail system on an average weekday in 1993, and Table 2-7 summarizes average weekday total boardings by line and for stations located within the Corridor. From this information it can be seen that 130,818 of the total unlinked trips (approximately 20 percent) involve a boarding at a station located within the Corridor. Of the lines in the system, the Green Line experiences the highest ridership activity in the Corridor with an average of 41,000 daily boardings, representing approximately 20 percent of total Green Line boardings.

2.2.4.3 Commuter Rail System

The MBTA operates an extensive commuter rail system that connects much of eastern Massachusetts with downtown Boston at North and South Stations. Based on a train passenger audit conducted on Thursday, June 8, 2000 the commuter rail system is estimated to carry approximately 126,000 passengers per day using diesel locomotives pulling passenger coaches. As shown in Figure 2-5, the existing system is divided into north system lines terminating at North Station and south system lines terminating at South Station. Of the total daily ridership, the North system lines account for approximately 46,000 per day (37%) and the South system lines approximately 80,000 per day (63%).

Commuter rail trains typically run on 25- to 40-minute headways during the morning and evening peak periods and one- to three-hour headways in off-peak periods. On a typical weekday, there are 397 daily trains provided. All lines except the Franklin Line also operate limited weekend service. Figure 2-5 shows the existing commuter rail system, daily boardings at each station and ridership for each line. The data only includes Ruggles, where a limited number of Needham, Franklin, Providence/ Attleboro, and Stoughton Line trains stop; Uphams Corner, where Fairmont trains stop; and Chelsea, where Newburyport/Rockport trains provide service. Toward the end of 2000 regular service was instituted at the Yawkey station stop on the Framingham/Worcester Line, and in Spring 2001 a new station was opened at JFK/UMass on the Old Colony Line. The Fitchburg Line, Haverhill Line, and Lowell Line do not have station stops in the Corridor, and the Newburyport/Rockport Line has no station within the Corridor between Chelsea and North Station. As a result, total commuter rail boardings in the Corridor remain relatively small.

2.2.4.4 Water Transportation

Several passenger ferry services are provided in the metropolitan area. Of these, only Massport's Logan Airport Water Shuttle and the MBTA's East Boston/Long Wharf shuttle serve the Corridor. A private company with a subsidy from Massport provides the Logan Airport service between Bird Island Flats and Rowes Wharf in downtown Boston. Average weekday ridership on this shuttle was 570 passengers in 1993. In August 1995, the MBTA began ferry service between the Lewis Street East Boston and Long Wharf.

2.2.4.5 Private Transportation Services

In addition to the extensive system of public transportation services, the Corridor is served by a number of private transportation services. These consist primarily of shuttle and circulator bus routes provided by a number of the major institutions, employers, and in one instance, a major shopping mall. The services are focused primarily in the Boston and Cambridge portions of the Corridor, and operate with fleets of both passenger vans and full size transit buses. In total, these systems carry approximately 16,400 passengers on an average weekday. Details pertaining to the existing private transportation services operating in the Corridor are contained in the technical memo documenting baseline conditions.

The private transportation systems in the Corridor provide two basic types of service:

- Feeder service between activity centers and existing transit stations;
- Line haul service between major nodes.

An example of the former is the UMass shuttle between the JFK Red Line Station and the nearby UMass campus. An example of the latter is the shuttle between the Harvard Medical School in the Longwood Medical Area of Boston and Harvard Square in Cambridge. With an absence of improved public transit service for crosstown trips in the Corridor, it can be expected that travel demand for both types of private transportation service will increase given the forecasted growth in Corridor trip making.

2.2.4.6 MBTA Reverse Commuting

As employment has increased in the suburbs over recent decades, the transportation demand for people living in urban areas and working in suburban areas has also increased. One of the goals of the MBTA is to improve reverse commute opportunities from the Boston urban core to outlying suburbs. The Urban Ring Corridor crosses all main Commuter Rail and Rapid Transit lines in the urban core area, which provide radial access to outer core and suburban locations. While there are opportunities to provide improved reverse commuter opportunities, there are several challenges¹⁵ that need to be considered and met. These include:

- Poor connections between residential neighborhoods and transit stations
- For most reverse commutes, transit service doesn't match travel time and convenience of driving¹⁶
- Incentives for non-work reverse commuting trips are small

Over the last 10 years, the MBTA has implemented the extensions of the Worcester, Old Colony, and Newburyport Commuter Rail lines, which has helped to improve reverse commute opportunities. The MBTA is committed to further improving reverse commute opportunities within the Corridor through projects such as the Urban Ring.

2.2.5 Future Public Transportation Network

The public transportation network serving the metropolitan area will see a number of major improvements between now and the 2025 design year. The following paragraphs describe the projects contained in the assumed Year 2025 "No Build" scenario. The No-Build scenario is based on the projects listed within the current version of the Regional Transportation Plan Update for the Year 2025. Additionally, though not listed in the 2025 Regional Transportation Plan, the Urban Ring 2025 "No-Build" scenario assumed using 3-car trains on the Green Line which would increase capacity compared to the current 2-car trains.

¹⁵ MBTA Reverse Commuting Report, 2001

¹⁶ Responses to Comments on Client Draft of MBTA Reverse Commuting Study Final Report, March 30, 2001.

Improvements range from those currently under construction to those at various stages of planning and project development. Figure 2-6 illustrates the programmed year 2025 major transit projects in relation to the existing radial transit system and the Corridor. These projects and the existing transit and bus system represent the 2025 transit “No Build” against which various Urban Ring “Build” alternatives are compared later in this report.

2.2.5.1 Bus System

The MBTA bus system of the future is assumed to undergo continuous incremental improvement in technology and service consistent with results of the MBTA’s Bus Service Planning Process. No details of the future bus system are presented herein, though the assumed 2025 bus system is contained in the CTPS 2025 network. The geographic coverage of the local bus system in the 2025 “No Build” scenario is expected be similar to the existing bus network depicted in Figure 2-3.

2.2.5.2 Rapid Transit System

- **Blue Line Modernization:** will lengthen station platforms to accommodate six-car trains and significantly increase capacity to serve the portions of the Corridor in East Boston and at Logan Airport.
- **Red Line/Blue Line Pedestrian Connection:** between Downtown Crossing and State Street Stations would provide a transfer between the Blue Line and the Red Line. This project will improve access between the Corridor Activity Centers along the Red Line (JFK/Morrissey Boulevard, Kendall Square and MIT/Massachusetts Avenue) and Logan Airport and East Boston. The connection will eliminate the additional transfer to the Green Line that is now required to make these trips.
- **Green Line Extension to Medford Hillside:** would follow the Lowell Commuter Rail right-of-way from Lechmere Station, four miles north through Somerville, to Medford. This project would provide a significant improvement in radial transit service to portions of the Corridor in Somerville and East Cambridge. The extension would shorten travel times and eliminate the bus/rail transfer that is now required.
- **Green Line North Station Improvements:** are under construction and consist of the relocation of the Green Line between Haymarket and Science Park and the construction of a new underground Green Line Station at North Station. The transit viaduct over Causeway Street is being removed and a more direct underground route will connect North Station and Science Park Station. Also included in the project are improved connections between the Green Line, Orange Line and commuter rail platforms. This project will improve access to the Orange Line and north side commuter rail services for those portions of the Corridor in the Lechmere area.
- **Silver Line, Phase I:** Phase I is under construction and consists of articulated bus service along a reconstructed Washington Street between Dudley Square in Roxbury and downtown Boston. The route will follow Washington Street to the Downtown Crossing area and improve radial transit service in portions of the Crosstown/Ruggles section of the Corridor.
- **Silver Line, Phase II:** Phase II is under construction and consists of a fixed guideway, dual-mode bus system extending from South Station to the areas of new development along the waterfront in South Boston, including the proposed new Boston Convention and Exhibition Center. This segment includes a tunnel connection from South Station to the Fan Pier/Federal Court House and the World Trade Center. The new service will improve access to the South Boston Piers area for those portions of the Corridor in Cambridge and the JFK/Morrissey Boulevard area now served by the Red Line. This system could ultimately be connected to Phase 1 of the Silver Line enabling a single seat ride from Dudley Square into the South Boston Waterfront, though the tunnel needed for such a connection is not currently programmed.

- **Silver Line, Phase III:** Phase III will connect Phases I and II of the Silver Line via a new subway alignment. This new alignment would go through downtown Boston to connect with the Orange Line at Chinatown Station and the Green Line at Boylston Station. Phases I and II of the Silver Line are being designed and constructed to accommodate this future connection.
- **Airport Intermodal Transit Connector:** Massport studied a series of alternatives to provide improved passenger circulation among the airline terminals, landside support facilities and the MBTA Blue Line at Logan Airport Station. The service will also link the airline terminals with the proposed new Boston Convention and Exposition Center in South Boston, and the Red Line at South Station via the Ted Williams Tunnel. The alternative selected is a bus technology and the service has been named the Airport Intermodal Transit Connector (AITC).
- **Arborway Green Line Service:** The project assumes restoration of Green Line service along the E branch from Heath Street stop to Arborway.

2.2.5.3 Commuter Rail Projects

A number of improvements are planned over the next 20 years for the commuter rail system, including the extensions of Commuter Rail service on the Greenbush Line, and the New Bedford/Fall River Line. The extensions will add ridership to the South system, but the 2025 No-Build provides no new commuter rail stations within the Corridor.

2.2.5.4 Major Projects Not Included in 2025 No-Build

Three major planning initiatives are underway which could result in additional public transportation improvements impacting the Corridor by the 2025 design year, but are not currently included in the Regional Transportation Plan, i.e. the Urban Ring 2025 No-Build scenario. However, none of the projects are intended to address crosstown mobility and would not significantly improve access along the Corridor.

- **The North-South Rail Link:** is the subject of an ongoing MBTA Major Investment Study and Draft Environmental Impact Statement (MIS/DEIS) to examine a number of alternatives for linking north side and south side commuter rail and Amtrak intercity service through downtown Boston. The alternatives under consideration include various options for commuter rail tunnels to connect North Station to South Station and possibly adding a new below-grade commuter rail station in the Financial District.
- **North Shore Transportation Improvements Project:** is currently the subject of an MBTA Major Investment Study (MIS) that commenced in 2000. The MIS is examining multi-modal, cost-effective alternatives for improved transportation in a large corridor encompassing 32 cities and towns east of Route 95 between the New Hampshire border and Boston. Alternatives may include commuter rail, intermodal transfer centers, express bus, highway improvements and extending the Blue Line.

2.2.6 Existing Rail Rights-of-Way

The Corridor is crossed by numerous active and abandoned rail rights-of-way, some of which are potential alignments for public transportation. The opportunities, however, are limited by the configuration of the existing rail system being predominantly radial and offering relatively few circumferential rights-of-way. Nearly all active or abandoned rail lines within or crossing the Corridor are held by one of the following three owners:

- CSX Corporation (formerly Conrail)
- Guilford Transportation Industries (Guilford)

- Commonwealth of Massachusetts

Appendix D contains a general description of the existing rail rights-of-way in the Corridor held by each of these owners, and critical right-of-way preservation issues.

2.2.7 Freight

The Corridor contains a number of major generators of freight and goods movement. The majority of these are located in the north and northeast portions of the Corridor, in Cambridge, Somerville, Everett, Chelsea and East Boston. While portions of the Corridor in Boston to the south and southeast at one time contained distribution centers for goods, most of that activity has since relocated.

By far the largest and most important freight generator in the Corridor is Logan International Airport, which serves as the primary air freight center for all of New England and handles cargo destined to or originating from all corners of the globe. While the airport proper and portions of the surrounding areas in East Boston used to be the primary centers of air freight forwarding activity, many of these uses are now moving to Chelsea. The area adjacent to Chelsea Creek has seen significant recent development of uses serving air freight forwarders and distribution uses as the petroleum industry has started to relocate out of this area.

In addition to the Chelsea and Logan Airport areas, a number of major distribution centers are located in or adjacent to the Corridor in portions of Everett, Somerville and, to a lesser extent, East Cambridge. Although many of these areas have freight rail access, the majority of freight activity is roadway based.

2.2.8 Transportation Plans and Policy

The Corridor extends through the six municipal jurisdictions (Boston, Brookline, Cambridge, Somerville, Everett and Chelsea) that comprise the Compact and is located within the boundaries of the Boston Metropolitan Planning Organization (MPO). The Urban Ring MIS is being directed at the state level by the MBTA Planning Department in coordination with the plans and policies of the Compact, the MPO, and other agencies as summarized below.

2.2.8.1 Approach

The wide range of government jurisdictions involved in the Corridor made it necessary to organize policy-related information into categories. The grass roots or "bottom-up" nature that has marked the Urban Ring planning process makes it logical to present policy descriptions in similar order as follows:

- Local Policy
- Regional Policy
- State Policy
- Federal Policy

This discussion focuses on those agencies and jurisdictions likely to have a direct role in the planning and/or implementation of Urban Ring transportation improvements, though other entities not discussed herein would also have some role. For local jurisdictions, the various documents obtained as part of the land use baseline data gathering effort were reviewed for policy statements that were then summarized. Through the MBTA, copies of various state level policy documents were obtained. Additional policy information was obtained from recent reports prepared by the MPO and one of its members, the Metropolitan Area Planning Council (MAPC). More detailed descriptions of the plans and policies at the local, regional, state, and federal level are contained in the baseline technical memo.

2.2.8.2 Local Policy

At the local level, each of the six local jurisdictions in the Urban Ring Regional Planning Compact provided information concerning its transportation plans and policies.

- **Boston**

Boston's transportation policies are directly related to its development policy which focuses on ensuring that future economic growth is balanced with the protection of neighborhoods and the environment. Within and adjacent to the Corridor, the City of Boston has undertaken numerous district planning efforts which relate directly to the Urban Ring and are supportive of transportation improvements in the Corridor. Additionally, a City-wide transportation master plan is being prepared whose goals and objectives include improved public transportation in the Corridor.

- **Brookline**

The Town of Brookline transportation policy is tied into its growth strategy of consolidating and enhancing existing developed areas. The portion of Brookline in the Corridor is near Boston University.

- **Cambridge**

The City of Cambridge growth policy seeks to reverse the trend, evident in recent decades, of progressively greater automobile use. With most employees commuting into Cambridge from other towns, the City seeks to encourage travel from those other towns by means other than the automobile where possible.

- **Somerville**

The City of Somerville has a policy of improving access as part of its efforts to revitalize the Assembly Square Commercial area. A master planning effort focusing on Union Square is currently underway.

- **Everett**

Within the City of Everett, the transportation priorities include adequate public transportation in the Parkway Industrial Area and the South Everett Industrial Area. The City seeks improved bus service to commercial and industrial centers of employment, and possibly a commuter rail station.

- **Chelsea**

The City of Chelsea's transportation policies are related to and supported by its growth policies. The policies include reducing the volume of commuter traffic that cuts through Chelsea, consolidating and relocating the off-ramps from Route 1 that currently pass by the high school and residential neighborhoods, and providing better public transportation to support redevelopment of the waterfront.

2.2.8.3 Regional Policy

- **Circumferential Ring Regional Planning Compact**

The six municipalities that formed the Compact in 1995 adopted a set of planning principles committed to working with the MBTA during the Urban Ring MIS and supporting the coordination of transportation and land use in the Corridor. Conversely, the Compact is focused on protecting the environment and established areas from negative growth impacts. The Compact has pledged to integrate land use, planning, and zoning initiatives with transit planning, and to support ridership on new transit services.¹⁷

¹⁷ Urban Ring Compact Final Draft Report, Urban Ring Planning Compact, September 2000.

The following major topics are discussed in the Urban Ring Compact Final Draft Report published in September 2000:

- Existing Land Use and projected Growth
- Corridor Land Use Policies
- Tools to Implement Land Use Policies
- Performance Land Use Policies
- Transit-Supportive Regulations Near Transit Stations
- Containment of Sprawl

◦ **Metropolitan Planning Organization (MPO)**

The MPO developed the current long-range transportation plan for the Boston region that includes the transportation policies that helped guide the development of the Urban Ring goals and objectives. The MPO recently completed the long-range transportation plan to the year 2025 which consists of policies, strategies, and priorities for transportation in the region over the next 25 years. The Plan was prepared according to guidelines outlined under TEA-21.

There are nine proposed policies and strategies outlined in the Plan to guide transportation actions over the next 25 years:¹⁸

- Policy 1** - Support economic vitality through transportation investments
- Policy 2** - Ensure and increase the safety of transportation system users
- Policy 3** - Improve mobility for people and freight by providing transportation options
- Policy 4** - Reduce air pollution and minimize water, soil, and noise pollution, and use transportation enhancement activities to preserve and improve the natural and built environments
- Policy 5** - Integrate and connect components of the transportation system, across and between modes
- Policy 6** - Provide a transportation system that is accessible to all people regardless of physical limitations, economic status, or ethnicity, and ensure benefits/burdens are shared equitably
- Policy 7** - Emphasize the preservation and modernization of the existing transportation system
- Policy 8** - Promote public involvement in all phases of transportation planning and development
- Policy 9** - Promote the integration of transportation land use policies

2.2.8.4 State Policy

The 1994 State Transportation Bond Bill passed by the legislature and signed into law contains authorization for conducting environmental studies on the Urban Ring. The Massachusetts Bay Transportation Authority (MBTA) is responsible for determining the need for transportation improvements in the Corridor and eventually progressing any identified projects through the environmental process. In September 1996, the MBTA issued its Service Delivery Policy as approved by the MBTA Board of Directors. The purpose of the Service Delivery Policy is to ensure that MBTA service meets customers' needs and that MBTA service is provided in a cost-effective manner. The MBTA is in the process of reviewing and updating its plans and policies to conform to recent legislation that restructured the MBTA budget process. While other state-level agencies and authorities have transportation responsibilities that

¹⁸ Boston MPO Transportation Plan, 2000-2025

sometimes relate to the Urban Ring, those agencies are generally focused on other modes. The MBTA continues to coordinate the Urban Ring MIS with other state agencies, such as the Massachusetts Port Authority and the Massachusetts Turnpike Authority.

2.2.8.5 Federal Policy

Federal policies most relevant to the Urban Ring MIS are those of the Federal Transit Administration (FTA) within the U.S. Department of Transportation. On June 9, 1998, the Transportation Equity Act for the 21st Century (TEA-21) was enacted, mandating that proposed transit New Starts projects must receive FTA approval to advance from alternatives analysis (i.e. the Urban Ring MIS) to preliminary engineering, and again from preliminary engineering to final design and construction. This approval will be based, in large part, on an evaluation of the proposed project against the FTA New Starts criteria. Additionally, the policies and criteria of several other federal agencies and policies are also potentially relevant because of the relationship of the Urban Ring to land use and economic development and brownfield redevelopment. Other federal agencies include Housing and Urban Development and the Environmental Protection Agency.

2.3 Land Use

Land use in the Corridor is comprised of neighborhoods and activity centers. For purposes of establishing a land use baseline, the Corridor was divided into 20 subareas which were then evaluated. The purpose of the subarea evaluation was to:

- Identify the major neighborhoods and activity centers along the Corridor and the various institutions, employment, retail/commercial and recreation centers throughout the area.
- Analyze the land use and urban design constraints to further development, revitalization and/or expansion, as well as potential opportunities in which transit access can support/enhance the development objectives in each of these subareas.

In addition, feedback was received from the six jurisdictions regarding future land uses within the subareas and was documented in a series of meeting minutes contained in a previous technical memo¹⁹.

2.3.1 Process

The study team reviewed past studies, met with representatives of the six jurisdictions, gathered information and conducted a windshield survey of the Corridor. Findings from this work are summarized below.

2.3.2 Findings

The following is a list of subareas defined by the jurisdiction representatives that fall within the Corridor:

- Columbia Point/Morrissey Boulevard (Boston)
- New Market/South Bay/Uphams Corner (Boston)
- Boston Medical Center (Boston)
- Crosstown/Ruggles (Boston)
- Longwood Medical Area (Boston, Brookline)
- Kenmore Square (Boston)

¹⁹ See *Technical Memorandum: Land Use and Urban Design Baseline*, Urban Ring Major Investment Study MBTA, ICF Kaiser Engineers, Inc. and Antonio DiMambro & Assoc., April 8, 1997.

- Boston University (Boston, Brookline)
- Cambridgeport (Cambridge)
- Mass Ave/MIT (Cambridge)
- Kendall Square (Cambridge)
- Lechmere/North Point (Cambridge)
- Community College (Boston)
- Sullivan Square (Boston, Somerville)
- Boynton Yards/Union Square (Somerville)
- Cobble Hill/Inner Belt Industrial Park/Brickbottom (Somerville)
- Assembly Square (Somerville)
- Everett Mystic River Area (Everett)
- Chelsea Creek/Downtown Chelsea (Chelsea)
- Logan Airport/East Boston (Boston)
- South Boston Waterfront (Boston)

The Corridor subareas are described in detail within the baseline technical memo including the existing conditions and key land use issues, zoning, development, constraints and opportunities.

2.4 Air Quality

A general air quality analysis was performed to evaluate the existing and future air quality levels in the Corridor in the absence of any transportation improvements not already programmed. A more detailed air quality evaluation will be conducted during the Environmental Impact Report/Statement review process, and will assess air quality levels for the existing conditions and quantify the impacts of the “No Build” and Build Conditions. These subsequent analyses will be performed based on U.S. Environmental Protection Agency (US EPA) procedures and guidance from the Massachusetts Department of Environmental Protection (MA DEP).

2.4.1 Regulatory Setting

The main federal legislation dealing with air quality is the Clean Air Act of 1970 (as amended in 1977 and 1990). The purpose of the Clean Air Act is to preserve air quality and to protect the public's health and welfare. Under the authority of the Clean Air Act and the 1990 Clean Air Act Amendments (1990 CAAA), the U.S. EPA established a set of ambient air quality standards for six criteria pollutants. The criteria pollutants are: carbon monoxide (CO); nitrogen dioxide (NO₂); ozone; particulate matter of 10 micrometers and smaller (PM₁₀); sulfur dioxide (SO₂); and lead. These standards are known as the National Ambient Air Quality Standards (NAAQS) and are summarized in Table 2-8.

Air quality standards define allowable limits for atmospheric concentrations of air pollutants. Individual states can develop and implement such standards as long as they are at least as stringent as the prevailing national standards. The Massachusetts Ambient Air Quality Standards, as described in Section 310 of the Code of Massachusetts Regulations Chapter 6 (310 CMR 6.00), are similar to the National standards and are also presented in Table 2-8. Primary standards are established to protect public health. Secondary standards are established at levels designed to protect the public welfare by accounting for the effects of air pollution on vegetation, soil, materials, visibility and other aspects of the general welfare. Compliance with these standards must be achieved by any project being constructed in the Commonwealth of Massachusetts.

The air pollutants of most concern in the assessment of impacts from this project are associated with emissions from mobile sources (locomotives and motor vehicles), and include CO, VOC and NO_x. CO is the only pollutant for which a detailed microscale impact analysis is required to comply with the NAAQS, and VOC and NO_x are the only pollutants for which a detailed regional analysis is required for compliance with the Massachusetts State Implementation Plan. There are no regulatory requirements to perform an assessment of PM₁₀ or SO₂ for this project.

2.4.2 Existing Ambient Air Quality in the Corridor

In order to determine compliance with the NAAQS, long-term air quality monitoring is conducted by the MA DEP. MA DEP operates several continuous monitoring sites in and around the Corridor which measure criteria pollutants. Tables 2-9, 2-10, and 2-11 summarize the most recent measured data available for the pollutants relevant for the Urban Ring project for year 2000.²⁰

There are three MA DEP-operated CO monitoring sites in the region around the project Corridor. These sites are all located in Boston and include Kenmore Square, 340 Bremen Street and the Federal Post Office Building in Post Office Square. Table 2-9 shows that there are no exceedances or violations of the state and federal one-hour CO standard of 35 parts per million (ppm) or the eight-hour CO standard of 9 ppm were recorded at any of these monitoring stations during 1995. The highest recorded one-hour CO concentration was 3.6 ppm at the Kenmore Square site, and the highest recorded eight-hour concentration was 3.0 ppm also at the Kenmore Square site.

There are three MA DEP-operated ozone monitoring sites in the region. These sites are in Lynn, Long Island Hospital Road and Harrison Avenue in Boston. As shown in Table 2-10 there were no exceedances of the state and federal ozone standard of 0.12 ppm in the region around the Corridor during 2000. The highest one-hour concentration was 0.100 ppm at the Lynn Site.

There are six MA DEP-operated NO₂ monitoring sites in the region around the Corridor. These include five sites in Boston (Kenmore Square, Bremen Street, Long Island Hospital Road, Harrison Avenue, and East First Street), and one in Lynn. There were no violations of the state and federal annual NO₂ standards (0.05 ppm) at any of these sites in 2000. The highest recorded annual average NO₂ concentration was 0.029 ppm at the Kenmore Square Site in Boston. Table 2-11 summarizes NO₂ levels at the six monitoring sites in the region.

2.4.3 Relationship of the Project to Air Quality Regulations

The 1990 CAAA established timetables and requirements for attaining the NAAQS and also included provisions for the US EPA to review transportation projects to determine whether they conform to the State Implementation Plan (SIP). The conformity provision states that no federal agency may approve, accept or fund any transportation plan, program or project unless such plan, program or project has been found to conform to an applicable state implementation plan in effect under the act (Title I, Section 101, Paragraph F of the 1990 CAAA). The 1990 CAAA established levels and timetables related to ozone and CO for each region not in attainment of the standards and directs these regions to develop revised SIPs. A SIP must demonstrate how a region plans to reach its attainment levels and timetables.

The Corridor extends through portions of Boston, Brookline, Cambridge, Somerville, Chelsea and Everett. Pursuant to the 1990 CAAA, these municipalities are located in an ozone non-attainment area identified as "Serious." Serious ozone non-attainment areas are defined as geographical areas with the fourth highest ozone concentration (the average hourly design value) ranging from 0.160 ppm to 0.180 ppm based on three consecutive years of monitoring data. The NAAQS for ozone is 0.12 ppm, which is not to be

²⁰ Air Data - Monitoring Values report, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC, accessed May 23, 2001.

exceeded more than once per year. This area of Massachusetts is required to reach attainment of the ozone standards by the year 1999.

With respect to CO, the Corridor had been classified as a "Moderate" CO non-attainment area. However, in December 1994, the MA DEP filed a Redesignation and Maintenance Plan to redesignate the area as being a CO maintenance area. Designation as a maintenance area indicates that the area has achieved attainment of the NAAQS after a period of non-attainment and that the SIP includes provisions to maintain the area's attainment status. The Redesignation Plan for the area was approved by EPA and took effect in April 1996.

Conformity is defined as meeting a SIP's purpose of eliminating or reducing the severity and number of violations of the NAAQS, and achieving expeditious attainment of those standards. To achieve conformity, projects must not cause or contribute to any new violation of the NAAQS, increase the frequency or severity of any existing violations of the NAAQS, or delay the timely attainment of the NAAQS (or any interim emission reduction standard or milestone).

Municipal Planning Organizations (MPOs) are responsible for determining an area's conformity with the SIP. The Corridor for the Urban Ring is located within the geographical boundaries of the Boston Metropolitan Planning Organization, which prepares the area's Transportation Program (TP) and Transportation Improvement Plan (TIP) for the SIP. Conformity of a specific project is achieved if a project is included in the emissions budget of a conforming TP or TIP. A project not included in a conforming TIP must prepare a project-level emissions analysis. Transportation improvements in the Urban Ring have been discussed but have not been included within the emissions budget calculations of a TIP found to conform to the MA SIP and the requirements of the 1990 CAAA. Therefore, as this project becomes further defined in the subsequent Draft Environmental Impact Report/Environmental Impact Statement (DEIR/DEIS), it will be required either to be included in the emissions budget of the TP or TIP, or to have a separate project-level conformity determination prepared. A project-specific mesoscale (emission inventory) analysis for this project will, therefore, need to be prepared.

2.5 Energy Consumption

The lack of adequate transit service in the Corridor contributes to the current level of congestion and delays on existing roadways within the corridor causing delays on existing crosstown bus routes and increasing their fuel consumption. The relative unattractiveness of transit for crosstown trip making leads to increased use of the automobile for relatively short trips. Crowding in the central subway system caused by the inefficient use of radial lines for crosstown trips requires more cars per train to meet peak loads in the central subway, thereby increasing energy consumption.

2.6 Noise and Vibration

The Federal Transit Administration (FTA) has prepared a guidance manual entitled *Transit Noise and Vibration Impact Assessment*²¹ that provides direction for preparing the noise and vibration section of environmental documents for mass transit projects. The FTA guidance manual sets forth the basic concepts, methods and procedures for documenting the extent and severity of noise and vibration impacts from transit projects.

Noise and vibration source levels from the FTA guidance manual were used to assess relative impacts from the various technology alternatives. In summary, the guidance manual indicates that conventional diesel buses generate more noise than Light Rail Transit (LRT) vehicles operating on welded rail, but that LRT would generate more vibration than conventional diesel buses given equivalent speed and distance to the receptor. Moreover, unlike noise, which would be eliminated by placing the alignment underground,

²¹ FTA Report DOT-T-95-16, April 1995

vibration can actually worsen with underground alignments depending upon the depth of tunnel, subsurface conditions and design of the tunnel.

For surface operations, an LRT operating at 50 miles per hour would impact a receptor 50 feet away with 73 VdB of vibration, but the vibration would drop off at slower speeds or at greater distances. FTA criteria levels define an annoyance vibration threshold of 72 VdB for residential receptors. It is extremely rare for vibration from train operations to cause any sort of building damage, even minor cosmetic damage. As a result, these vibration levels are not expected to result in adverse impacts at residential receptors along the proposed project alignments. However, for receptor locations along the proposed rail corridor that have extremely sensitive equipment (such as the Massachusetts Institute of Technology Research Labs, Boston University, and the Longwood Medical Center), possible vibration impacts may occur. Vibrations from trains can potentially impact the reliability of laboratory results in addition to sensitive equipment impacts. Potential Noise and vibration impacts are discussed in Chapter 5.

Sensitive receptors such as research laboratories could also potentially be impacted by electromagnetic interference (EMI) given off by the overhead catenary power system associated with the LRT technology. The equipment most sensitive to EMI involves nuclear magnetic resonance (NMR) and electron paramagnetic resonance (EPR), although other types of research and equipment are also sensitive. The sensitivity of current equipment is evidenced by the fact that MIT Building NW14 can detect magnetic perturbations from the MBTA Red Line approximately 1,300 feet away. It appears that the most serious interference would be from low frequency magnetic fields in the range of 0 to 10 Hz. Some equipment, particularly NMR equipment requires shielding. A future concern focuses on whether current shielding will be able to provide adequate protection against low frequency magnetic fields produced by electric trains. Potential impacts of EMI are discussed in Chapter 5.

2.7 Water Resources

Water-related resources within the proposed Corridor were examined to provide a preliminary evaluation of potential issues and development constraints within the Corridor. This evaluation was based solely upon existing information and data available from prior studies. Detailed assessments of project impacts to these resources and the regulatory implications of the project will be required for the DEIR/DEIS. Existing water resources within the Corridor are described by the categories below.

2.7.1 Water Bodies and Waterways

The Corridor crosses several water bodies and waterways. Project impacts to water bodies and waterways are regulated under a variety of resource protection regulations administered by municipal, state and federal agencies. These regulations and the administering authorities are presented in the baseline technical memo. Project impacts to water bodies and waterways within the Corridor generally must be permitted under the regulations pertaining to the resource area and the impact.

Boston Harbor and the Inner Harbor are situated at the Logan Airport end of the Corridor. Counterclockwise from Logan Airport, the Chelsea River defines the Boston/Chelsea city boundary. The Corridor crosses the Mystic River at the confluence of the Malden River, and the impounded Charles River Basin in the vicinity of the Harvard and Boston University Bridges. To the south, the Corridor crosses the Muddy River (a non-coastal waterway) between Brookline Avenue and the confluence with the Charles River. The southern end of the Corridor abuts Dorchester Bay in the vicinity of Old Harbor, Savin Hill Cove and Malibu Beach.

2.7.2 Wetlands

The Corridor contains a number of regulated wetland resource areas. Most of these are associated with the major waterways within the Corridor, as described below.

2.7.2.1 Regulatory Overview

Project impacts to wetlands in Massachusetts are regulated at the federal and state levels, and at the local level within municipalities having non-zoning wetlands protection bylaws. These regulations and the administering authorities are presented in the baseline technical memo. Applicable authorities generally must permit any project impacts to wetlands under the regulations that pertain to the resource areas and the specific project impact. Wetland protection regulations generally require that project impacts to wetlands be avoided where practicable, minimized if they cannot be avoided, and mitigated.

None of the communities within the Corridor have designated restricted wetlands; therefore, the Wetlands Restriction Act does not pertain to the project. The Massachusetts Rivers Protection Act also regulates development within 25 to 200 feet of the banks of naturally flowing perennial streams and is administered through 310 CMR 10.00. None of the municipalities within the Corridor have promulgated non-zoning wetlands protection bylaws.

2.7.2.2 Inland Wetlands

Four types of inland wetland resource areas are subject to protection under the Massachusetts Wetlands Protection Act and accompanying regulations. Each of these wetland resource types occur within the Corridor. Additionally, non-wetland areas within 100 feet laterally of the boundaries of regulated wetlands are also subject to state jurisdiction. Such areas are referred to as Buffer Zones.

Another inland wetland resource area subject to protection under Massachusetts regulations is the Riverfront Area, which consists of the land area within 200 feet of the mean annual high water mark on each side of a naturally flowing perennial stream. This resource area, subject to protection under the Massachusetts Rivers Protection Act, is protected as a resource area rather than as a buffer zone. In certain urban areas, the riverfront area is reduced to 25 feet on each side of the mean annual high water mark. These urban areas include the cities of Boston, Chelsea, Everett, Somerville and Cambridge, but not Brookline.

2.7.2.3 Coastal Wetlands

Eleven categories of coastal wetland resource areas are subject to protection under the Massachusetts Wetlands Protection Act and accompanying regulations. Most of these resource types occur within the Corridor.

2.7.3 Corridor Wetlands

The locations of the wetlands within the Corridor were determined by examination of National Wetlands Inventory maps of the Boston North and Boston South quadrangles, as prepared by the U.S. Fish and Wildlife Service (1979). The wetlands located within the Corridor generally correspond to the water bodies and waterways described above. Field investigation to determine the precise location and extent of wetlands will be necessary for permitting of project wetland impacts.

At the Logan Airport end of the Corridor, the Boston Harbor and Inner Harbor qualify as coastal wetlands, and include open water estuaries and tidal flats. The Chelsea River is also a coastal estuary having a tidal flat. A freshwater marsh is situated in Chelsea west of the Chelsea River within a triangle formed by Conrail, Boston and Maine railroad tracks, and Eastern Avenue. Further to the west along the Corridor, the Malden River is a non-tidal tributary of the Mystic River, which is impounded just below the confluence with the Malden River by the Amelia Earhart Dam. Below this dam, the Mystic River qualifies as a tidal

wetland. Southward from the Mystic River, the Corridor passes over a very small inland open-water wetland in Cambridge on Broadway near the Conrail line. The impounded Charles River Basin along the Cambridge/Brookline/Boston city boundary is a non-tidal wetland resource area. The Muddy River, a tributary to the Charles, qualifies as an inland wetland. At the southern end of the Corridor, Old Harbor, Dorchester Bay and Savin Hill Cove qualify as coastal wetlands, and consist of open water estuaries, tidal flats, and coastal beaches at Carson Beach and Malibu Beach. A small area of open tidal water is situated west of Morrissey Boulevard near Savin Hill Cove.

2.7.4 Other Wetland Issues

2.7.4.1 Wildlife Habitat

No certified vernal pools, an inland wetland resource type protected under the Massachusetts Wetlands Protection Act primarily for wildlife habitat value, occur within the Corridor. Similarly, no Estimated Habitat of Rare Wildlife, another resource subject to protection under the Massachusetts Wetlands Protection Act, occurs within the Corridor, although two such areas are situated near the Corridor and are described in Appendix E. Two of the waterways within the Corridor, the Charles and Mystic Rivers, are identified by the Massachusetts Executive Office of Environmental Affairs Office of Coastal Zone Management (MCZM) as having anadromous/catadromous fish runs. This resource is subject to protection under 310 CMR 10.35 of the Massachusetts Wetlands Protection Act regulations.

2.7.4.2 Areas of Critical Environmental Concern

The Massachusetts Executive Office of Environmental Affairs (EOEA) has designated no Areas of Critical Environmental Concern (ACECs) within the Corridor, as determined by examination of MA DEP natural resources maps. Potential indirect project impacts to this ACEC may need to be considered during the preparation of the DEIR/DEIS.

2.7.4.3 Floodplains

Alterations of 100-year floodplains are regulated under the Massachusetts Wetlands Protection Act. In addition, Executive Order 11988²² requires that projects involving federal funds avoid, to the greatest extent possible, the long- and short-term impacts associated with the occupancy and modification of floodplains and to avoid direct or indirect support of floodplain development whenever there is a practicable alternative. The primary interests of floodplain regulations are avoiding the loss of floodwater storage capacity and avoiding placement of structures that could be damaged by flood waters within flood-prone areas.

Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps were examined for each of the communities through which the Corridor passes to determine where floodplains are located. In general, these floodplains consist of narrow bands of low-lying land adjacent to waterways. A description of the location of floodplains as depicted on the FEMA maps within the Corridor is presented in the baseline technical memo. None appear to present a fatal flaw to any of the alternatives considered.

2.7.5 Massachusetts Coastal Zone Management

The Corridor includes several large areas identified by the Massachusetts Executive Office of Environmental Affairs Office of Coastal Zone Management (MCZM) as lying within the Coastal Zone. These include portions of the communities of Chelsea, Everett and Somerville, as well as portions of the East Boston, Charlestown, South Boston and North Dorchester neighborhoods of Boston. The boundary of the Coastal Zone within the Corridor is depicted on the environmental baseline figures contained in the baseline technical memo.

²² Floodplain Management, May 24, 1977

2.7.6 Massachusetts Public Waterfront Act

The placement and use of fill or structures within the limits of flowed (existing) or filled (historic) tidelands requires a Chapter 91 Waterways License pursuant to the Massachusetts Public Waterfront Act and associated regulations (310 CMR 9.00) as regulated by the MA DEP Division of Wetlands and Waterways.

Certain areas of the Corridor contain currently flowed tidelands and/or are located over formerly flowed tidelands. This is particularly true along the Chelsea, Island End, Malden, Mystic and Charles Rivers in East Boston, Chelsea, Everett, Somerville and Cambridge. The lands of the southern terminus of the Corridor also include significant areas of formerly flowed tidelands. It should be noted, however, that Chapter 91 jurisdiction does not extend to landlocked tidelands²³.

The Chapter 91 regulations recognized that "Public Service Projects" infrastructure activities, such as the Urban Ring project, may require the placement of fill or structures within filled or flowed tidelands for the purpose of providing transportation services to the public (310 CMR 9.55). Such projects are treated similarly to water-dependent projects and are assumed to serve a proper public purpose. As such, the specific standards applied to non-water dependent projects are unlikely to be applied to the Urban Ring.

2.8 Historical and Archaeological Resources

The Corridor encompasses a large number of state- and federally-listed historic and/or archeological landmarks, sites, buildings and districts. A preliminary review of these resources has been conducted utilizing the databases of the Massachusetts Historical Commission. The following section reviews the key issues associated with these resource areas as they relate to the Urban Ring project. Regulations governing historical and archaeological resources within the Corridor are described in the baseline technical memo.

The State Register of Historic Places (1996) prepared by the Massachusetts Historical Commission (MHC) includes several hundred historic sites within or proximate to the Corridor. These sites range from small, individual landmarks to large, National Register Historic Districts encompassing whole city blocks. The Historic Districts identified during the analysis are listed in the baseline technical memo.

The State Register of Historic Places does not include information on locations of archaeological sites, stating that "specific locational information is not provided for archaeological sites to protect them from possible harm." It is not anticipated that undisturbed archaeological sites will be encountered within the Corridor due to the intensive land development within the area, although such sites may exist on or near the corridors of some of the area's larger waterways. An intensive locational survey will be required during the DEIR/DEIS phase of the Urban Ring project to document archaeological sites within the proposed work area.

2.9 Parklands

The Corridor contains many local and Commonwealth-owned and maintained parks, recreational areas, and green spaces. In East Boston, the most prominent of these are Central Square, the athletic field at the entrance to Logan Airport, Orient Heights Beach and the American Legion Playground. In Chelsea, the Corridor includes Merritt Park, Highland Park, Malone Park and Memorial Stadium, as well as the greenway along the Revere Beach Parkway between Route 99 and the Mystic River Bridge in Everett. The Corridor includes a portion of the Mystic River Reservation in Medford, and Foss Park and the Glen Street Playground in Somerville. In Cambridge, the Corridor contains Donnelly Field, John J. Ahearn Field, Sennot Park and Briggs Field. A greenway extends along both the Cambridge and Brookline/Boston banks of the Charles River. In Brookline, the Corridor contains Armory Playground and the greenway along the Muddy River, a portion of which lies in Boston. Within Boston, the Corridor includes Fenway Park, the Back Bay fens, the Mission Hill Playground, the Carter Playground, Orchard Park, the William

²³ Landlocked tidelands are defined as those filled tidelands that are entirely separated from flowed tidelands by a public way, except where they are within 250 feet of the existing high water mark.

Eustis Playground, Columbus Park, Carson Beach, Savin Hill Park, McConnell Park, Malibu Beach and greenways along Morrissey Boulevard.

Local communities, such as East Boston, may have recently dedicated more parkland areas than described above. Additionally, some parklands or greenways are not depicted in Appendix E due to their small size or very narrow configuration. An example of a narrow greenway is the landscaped Corridor along Melnea Cass Boulevard in Boston.

Implementation of transportation improvements within the Corridor has the potential to impact parklands in a number of direct and indirect ways, though at the conceptual level of analysis no specific impacts have yet been identified. Potential impacts include direct takings, construction period impacts, operational noise and vibration impacts, aesthetic impacts, and changes to parkland character by alteration of adjacent land uses.

It is important to note that the law applies not only to public parks and recreation lands, but also to all historic sites. The interpretation of "use" is not limited to the actual taking or acquisition of land on a temporary or permanent basis, but also includes proximity impacts. If the proximity impacts on a 4(f)²⁴ site are so great that the purpose for which the 4(f) site exists are substantially impaired, and/or that the enjoyment of the site is essentially precluded, these impacts constitute a taking.

2.10 Hazardous Materials

A review of the New England DataMap Technology Corporation Environmental FirstSearch database was performed to determine the presence of state-listed Priority Disposal Sites, solid waste landfills and National Priority List (Superfund) Sites within the Corridor. This review presents a summary of relatively major known hazardous waste sites and landfills within the Corridor, and does not provide a complete compilation of all releases of oil and hazardous materials.

The database review determined that approximately 300 state-listed Priority Disposal Sites and 12 MA DEP-listed solid waste landfills are located within the Corridor area. No National Priority-listed sites were identified within the Corridor. The locations of these sites are depicted on the figures contained in the baseline technical memo.

The impact of the presence of hazardous materials release sites within the Corridor will be determined by a wide range of factors, including the actual transportation right-of-way, the work and use proposed at the location, and the nature of the release. In that these listed sites are presumably undergoing review and resolution per the Massachusetts Contingency Plan, some will likely be cleaned-up prior to project implementation, while others may result in specific project-related actions. These issues will need to be addressed during the DEIR/DEIS and design phases of the project.

²⁴ Section 4(f) of the Department of Transportation Act restricts the use of USDOT funds for projects affecting the following properties: publicly owned land from a public park, recreation area or wildlife and waterfowl refuge, or any land from a significant historic site.

Table 2-1

Comparison Of Regional And Urban Ring Corridor Growth Rates ²²

Demographic	1995	2010	2025
Employment			
Urban Ring Corridor	237,616	325,285	360,269
% Growth from 1995		36.9%	51.6%
MAPC Regional Total	1,708,500	1,966,683	2,175,941
% Growth from 1995		15.1%	27.4%
Population			
Urban Ring Corridor	270,804	304,003	313,839
% Growth from 1995		12.3%	15.9%
MAPC Regional Total	3,044,982	3,133,587	3,245,120
% Growth from 1995		2.9%	6.6%

²² Analysis of Economic Development Factors – Alternatives A and B, Cambridge Systematics, Inc., April 3, 2001 (Preliminary Draft).

Table 2-2
Average Number of Transfers and Effective Transit Speed in 1990
from Sample External Origins to Urban Ring Corridor Destination

External Origin	Average Transfers Required to Reach Corridor Destination	Average Effective Travel Speed
South Station	0.9	6.8 mph
North Station	0.8	6.9 mph
Waltham	1.4	9.3 mph
Needham	1.3	11.8 mph
Gloucester	1.5	18.2 mph
Ipswich	1.5	18.9 mph
Acton	1.4	18.7 mph
Framingham	1.5	15.8 mph
Franklin	1.4	18.4 mph
Sharon	1.4	16.7 mph
Stoughton	1.4	15.9 mph
Cohasset	1.8	17.3 mph
Andover	1.7	14.9 mph
Billerica	1.7	18.1 mph
Brockton	1.4	18.0 mph
Halifax	1.1	23.0 mph
Averages	1.4	15.5 mph

Table 2-3
Average Number of Transfers and Effective Transit Speed in 1990
from Selected Urban Ring Origins to Corridor Destinations

Corridor Origin	Average Transfers Required To Reach Corridor Destination	Average Effective Travel Speed
Boston Medical Center	1.1	5.8 mph
North Point/Community College	1.2	7.0 mph
Sullivan Square	1.0	7.1 mph
Kenmore Square/BU	1.1	6.5 mph
Longwood Medical Area	1.1	7.0 mph
Columbia Point	0.9	7.7 mph
Logan Airport	1.5	7.8 mph
Chelsea Downtown ²⁵	1.5	15.7 mph
Mass. Ave./MIT	1.2	5.6 mph
Averages	1.2	7.8 mph

²⁵ The average effective transit speed of trips originating in Chelsea reflects a portion of the transit trip that is made on commuter rail (Rockport Branch).

Table 2-4
Existing MBTA Radial Bus Routes in Study Corridor ²³

Route No.	Route Name	Average Weekday Ridership²⁶
14	Roslindale Square - Dudley Square	964
17	Fields Corner - JFK Umass	3,741
18	Ashmont - Andrew	688
22	Ashmont - Ruggles Station via Jackson Square	8,334
23	Ashmont - Ruggles Station via Washington	11,701
28	Mattapan - Ruggles Station	11,693
39	Forest Hills - Back Bay Station	17,405
41	Centre & Elliot Streets - Dudley Station	1,027
42	Forest Hills - Ruggles Station	3,783
43	Ruggles Station - Park & Tremont Streets	3,741
45	Franklin Park - Ruggles Station	3,876
49	Dudley Square - Downtown	7,551
55	Queensbury - Copley Square/Park & Tremont	916
57	Watertown Square - Kenmore	8,850
60	Chestnut Hill - Kenmore	1,619
65	Brighton Center - Kenmore	1,683
80	Arlington Center - Lechmere	2,095
83	Rindge Avenue - Central Square Cambridge	2,840
85	Spring Hill - Kendall	399
87	Arlington Ctr./Clarendon Hill – Lechmere via Som.	3,720
88	Clarendon Hill – Lechmere via HL	4,299
89	Clarendon Hill - Sullivan	3,638
92	Assembly Square Mall - Downtown	1,506
93	Sullivan - Downtown	4,629
95	West Medford - Sullivan	1,679
99	N.E. Memorial Hospital - Wellington	1,681
100	Elm Street - Wellington	955
108	Linden Square - Wellington	2,708
109	Linden Square - Sullivan	2,680
111	Woodlawn - Haymarket	8,107
116	Wonderland - Maverick via Revere Street	4,680
117	Wonderland - Maverick via Beach Street	4,289
120	Orient Heights - Maverick	2,919
121	Wood Island - Maverick	318
Total Radial Routes		140,714

²³ The bus routes in this table are judged to serve primarily a radial function, although portions of individual routes may also provide limited crosstown connections.

Source: CTPS/MBTA Ridecheck Program/Typical Boarding (unlinked trips) Spring 1997 through Spring 2000.

Table 2-5
Existing MBTA Crosstown Bus Routes in Study Corridor²⁷

Route No.	Route Name	Average Weekday Ridership²⁸
1	Harvard - Dudley Square	12,557
5	City Point – McCormack Housing Project	173
8	UMass - Ruggles Station	5,270
10	City Point - Copley Square	3,546
15	Kane Square or Fields Corner - Ruggles	6,998
16	Forest Hills – UMass	4,333
19	Fields Corner – Ruggles	1,903
44	Jackson Square – Ruggles	4,046
46	Heath Street - Dudley	500
47	Central Square, Cambridge - Albany Street	3,625
64	Oak Square – Central Square, Cambridge	1,608
66	Harvard Square – Dudley	10,678
69	Harvard – Lechmere	3,388
70	Cedarwood – Central Square, Cambridge	5,069
86	Sullivan - Cleveland Circle	4,757
90	Davis Square – Wellington	1,280
91	Sullivan - Central Square, Cambridge	1,970
97	Malden – Wellington	535
101	Malden Station – Sullivan, via Salem/Main/Bdwy	4,217
104	Malden Station – Sullivan, via Ferry Street	3,310
105	Malden Station – Sullivan, via Faulkner/Main	975
106	Lebanon Street, Malden - Wellington	2,504
110	Wonderland or Broadway/Park - Wellington	2,513
112	Wellington – Maverick	1,338
119	Northgate – Beachmont	1,072
CT1	Central Square, Cambridge - BU Medical Center	2,192
CT2	Kendall Square, Cambridge - Ruggles	1,208
CT3	Beth Israel Hospital - Andrew	1,294
Total Crosstown Routes		92,859
Total Radial Routes		140,714
Total All Routes in Study Corridor		233,573
Total All MBTA Bus Routes		377,339
Study Corridor Routes as Percent of Total System		62%

²⁷ The bus routes in this table are judged to serve primarily a crosstown function within the study area, although portions of individual routes may also provide radial connections.

Source: CTPS/MBTA Ridecheck Program/Typical Boarding (unlinked trips) Spring 1997 through Spring 2000.

Table 2-6
Ridership Trends for Study Corridor Circumferential Routes

Route	Average Weekday Ridership by Date of Count						Ridership Growth
	10/94	11/94	1/95	4/95	9/95	Spring 97 ²⁵	(10/94 – Spring 97)
CT1	1,557	1,801	2,039	2,033	2,295	2,192	41%
CT2	550	545	722	832	827	1,208	120%
CT3	644	688	778	846	1,201	1,294	98%
Total	2,751	3,034	3,539	3,711	4,323	4,694	71%

²⁵ Includes surveys performed between Spring 1997 and 2000.

Sources: MBTA Operations Planning and Scheduling Department, 1997; CTPS/MBYA Ridecheck Program, Typical Boarding (unlinked trips) Spring 1997 through Spring 2000.

Table 2-7
MBTA Rapid Transit and Light Rail Line Boardings
Average 1997 Weekday²⁶

Transit Line		Boardings
Red Line	Total Study Corridor Station	36,926
	Total Line	217,891
	Study Corridor Percent of Line Total	17%
Orange Line	Total Study Corridor Station	37,289
	Total Line	164,065
	Study Corridor Percent of Line Total	23%
Blue Line	Total Study Corridor Station	15,603
	Total Line	57,301
	Study Corridor Percent of Line Total	27%
Green Line	Total Study Corridor Station	41,000 ²⁷
	Total Line	202,612
	Study Corridor Percent of Line Total	20%
Rail System Totals	Total Study Corridor Station	130,818
	Total Line	641,869
	Study Corridor Percent of Line Total	20%

²⁶ MBTA, 1997.

²⁷ ²⁷ Estimated based on Study Corridor Percent from Average 1993 Weekday Boardings.

Table 2-8
Massachusetts and National Ambient Air Quality Standards

Pollutant	Standard	Averaging Period	Massachusetts	National
Carbon Monoxide	Primary & Secondary Primary & Secondary	8-hour average 1-hour average	10 mg/m ³ (9 ppm) 40 mg/m ³ (35 ppm)	9 ppm (10 mg/m ³) ^c 35 ppm (40 mg/m ³) ^c
Ozone	Primary & Secondary	1-hour average	0.12 ppm (240 µg/m ³)	0.125 ppm (235 µg/m ³) ^d
Nitrogen Dioxide	Primary & Secondary	Annual arith. mean	100 µg/m ³ (0.05 ppm)	0.05 ppm (100 µg/m ³)
Sulfur Dioxide	Primary Primary Secondary	Annual arith. mean 24-hour average ^b 3-hour average	80 µg/m ³ (0.03 ppm) 365 µg/m ³ (0.14 ppm) 1300 µg/m ³ (0.5 ppm)	80 µg/m ³ (0.03 ppm) 365 µg/m ³ (0.14 ppm) 1300 µg/m ³ (0.5 ppm)
Inhalable Particulates (PM10)	Primary & Secondary Primary & Secondary	Annual arith. mean 24-hour average	50 µg/m ³ 150 µg/m ³	50 µg/m ³ 150 µg/m ³
Lead	Primary & Secondary	Calendar quarterly mean	1.5 µg/m ³	1.5 µg/m ³
Notes: a = National short-term standards are not to be exceeded more than once in a calendar year. b = National standards are block averages rather than moving averages. c = National secondary standards for carbon monoxide have been dropped. d = Maximum daily 1-hour average (averaged over a three year period, the expected number of days above the standard must be less than or equal to one).				

Table 2-9
2000 Monitored Carbon Monoxide (ppm) in the Project Corridor

Carbon Monoxide Monitoring Sites	1-Hour Average ^a		No. Hrs. Above 35 PPM	8-Hour Average ^b		No. Hrs. Above 9 PPM
	Highest	2 nd High		Highest	2 nd High	
Kenmore Square, Boston	3.6	3.4	0	3.0	2.3	0
Bremen Street, Boston	3.5	3.0	0	2.4	2.4	0
Post Office Bldg., Boston	3.0	2.9	0	2.2	2.1	0

Notes:

- a. The 1-Hour CO Massachusetts and National Ambient Air Quality Standard is 35 ppm, not to be exceeded more than once per year.
- b. The 8-Hour CO Massachusetts and National Ambient Air Quality Standard is 9 ppm, not to be exceeded more than once per year.

Table 2-10
2000 Monitored Ozone (ppm) in the Project Corridor

Ozone Monitoring Sites	Daily Maximum 1-Hour Averages		No. of Days With 1-Hr Concentrations Above 0.12 ppm
	Highest	2 nd Highest	
Lynn	0.100	0.085	0
Long Island Hospital Rd., Boston	0.092	0.089	0
Harrison Avenue, Boston	0.091	0.078	0

Notes:

- a. The National Ambient Air Quality Standard is 0.12 ppm averaged over a three-year period and the expected number of days above the standard must be less than or equal to one.

Table 2-11

2000 Monitored Nitrogen Dioxide (ppm) In the Project Corridor

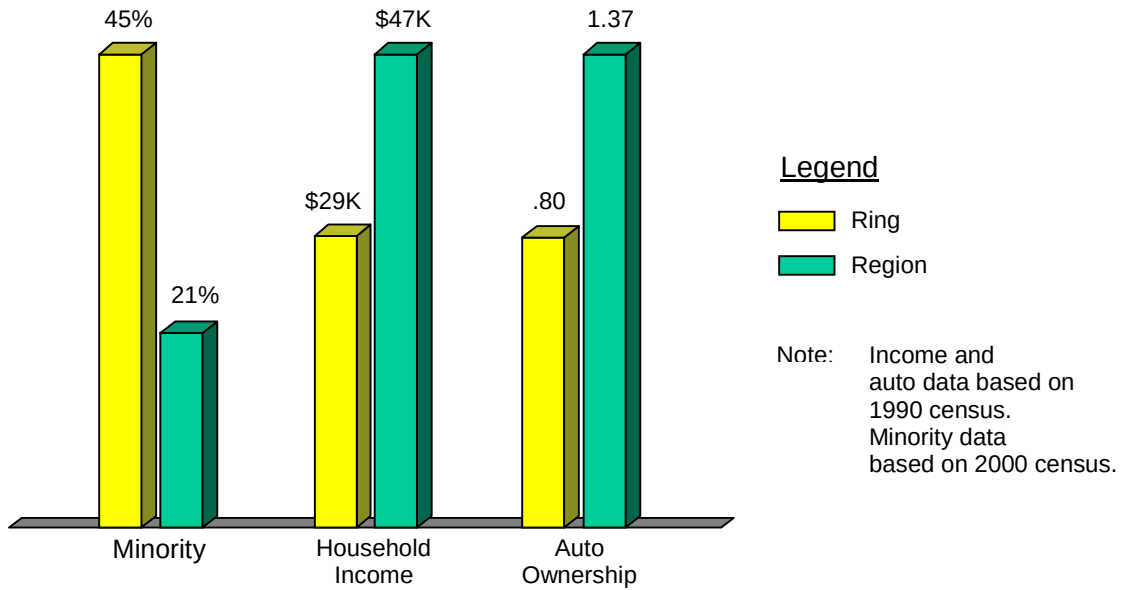
Nitrogen Dioxide Monitoring Sites	Average Annual Concentration ^a
Kenmore Square, Boston	0.029
Bremen Street, Boston	0.022
Long Island Hospital Road, Boston	0.011
Harrison Avenue, Boston	0.024
East First Street, Boston	0.020
Lynn	0.011

Notes:

- a. The Annual NO_2 National Ambient Air Quality Standard is 0.05 ppm (100 g/m^3) not to be exceeded more than once in a calendar year.

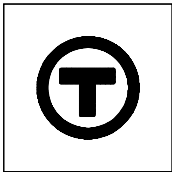
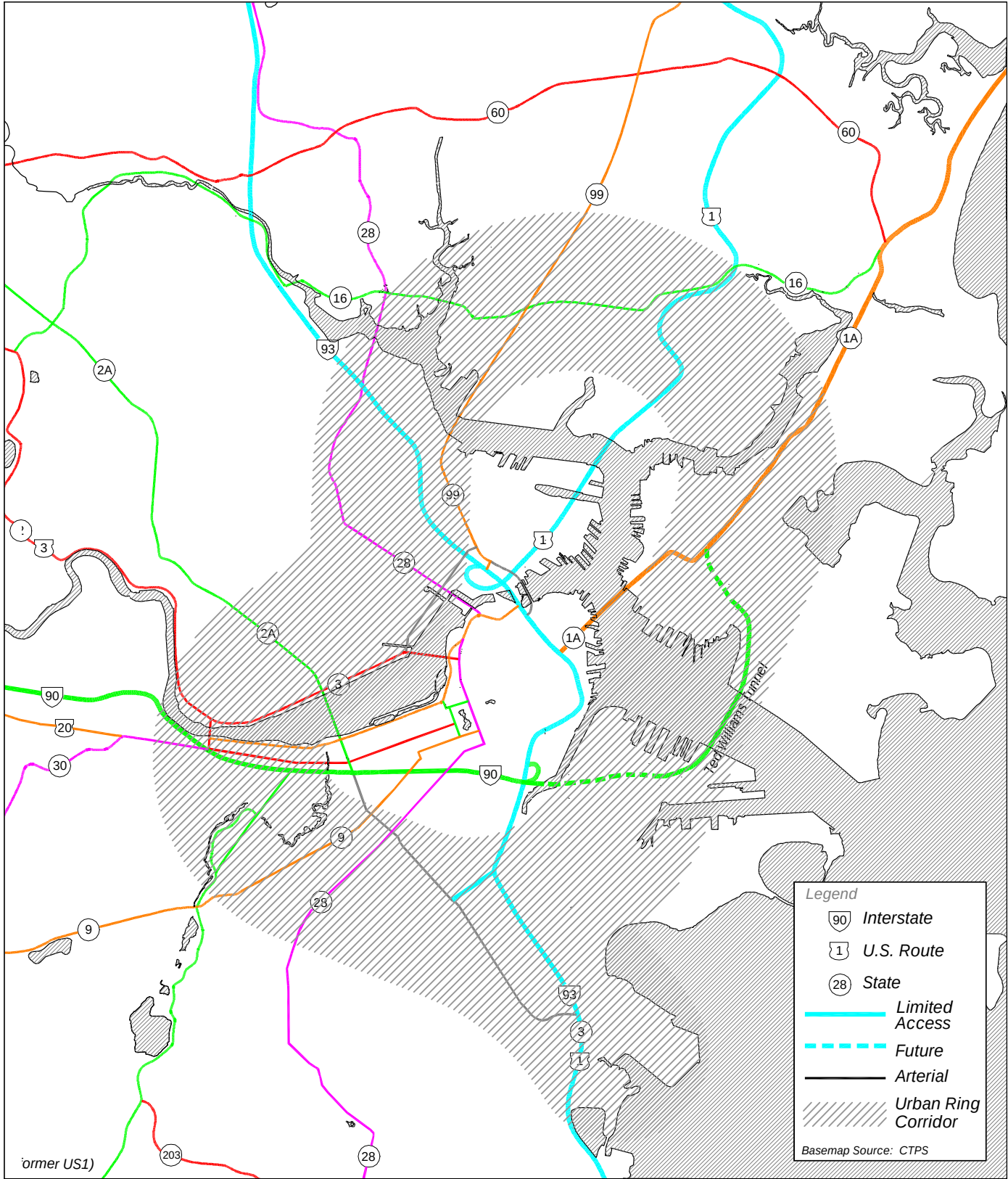
Source: US EPA, July 1996

Figure 2-1
Demographic Indicators of Transit Need
Urban Ring Corridor Compared to Region





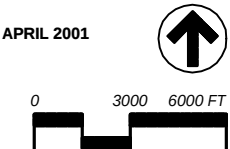
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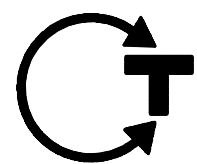


Roadway Network

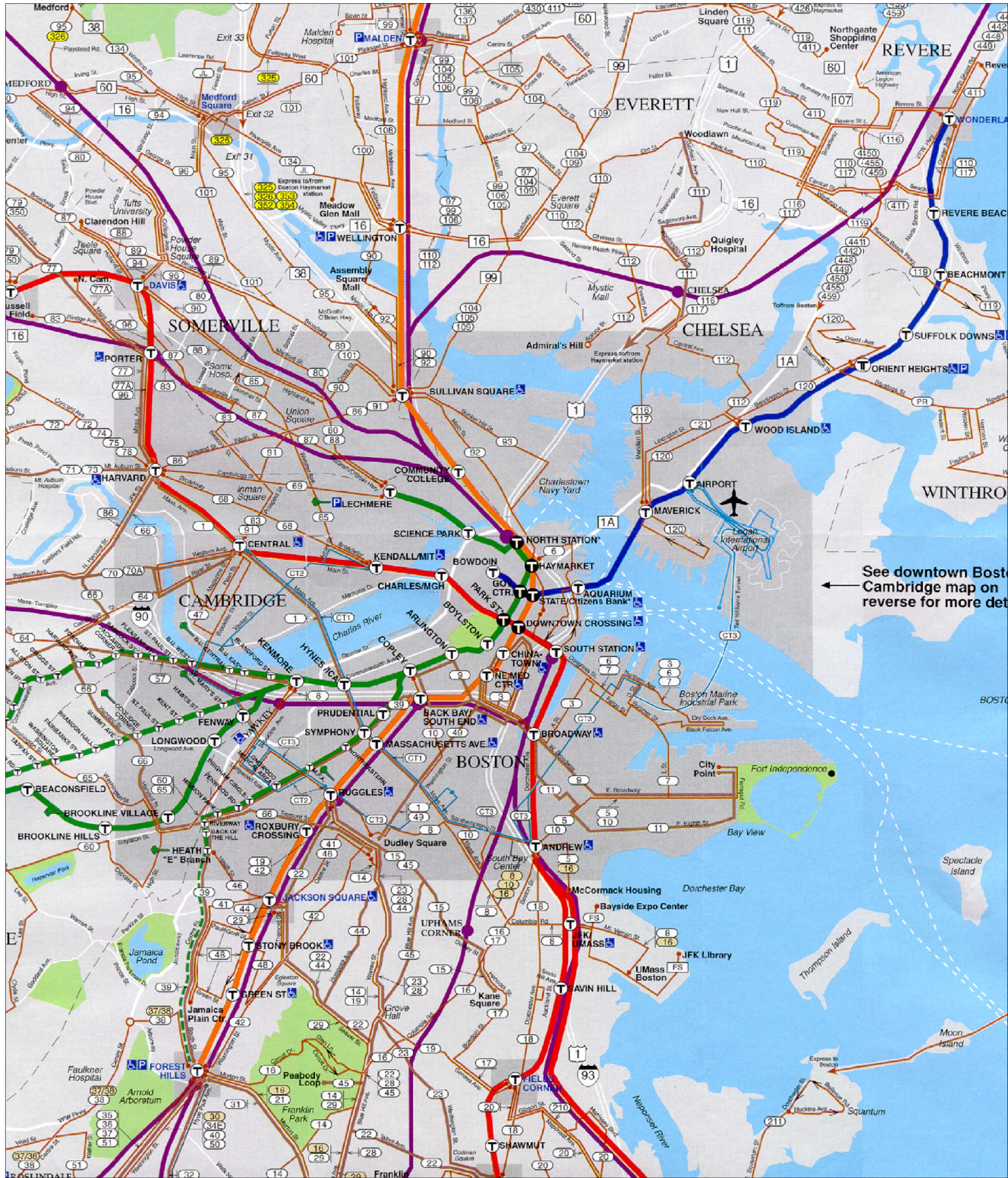
Existing and Future

Figure 2-2

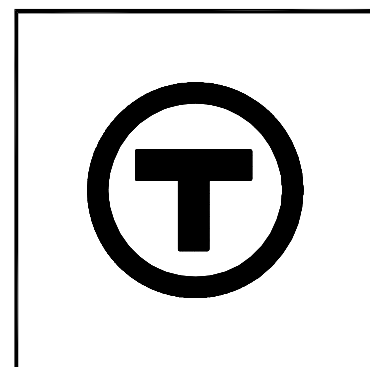




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See downtown Boston
Cambridge map on
reverse for more det



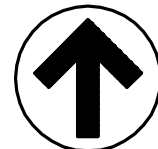
Existing Public Transportation Network

Bus Routes and Radial Transit

EARTH  TECH

Figure 2-3

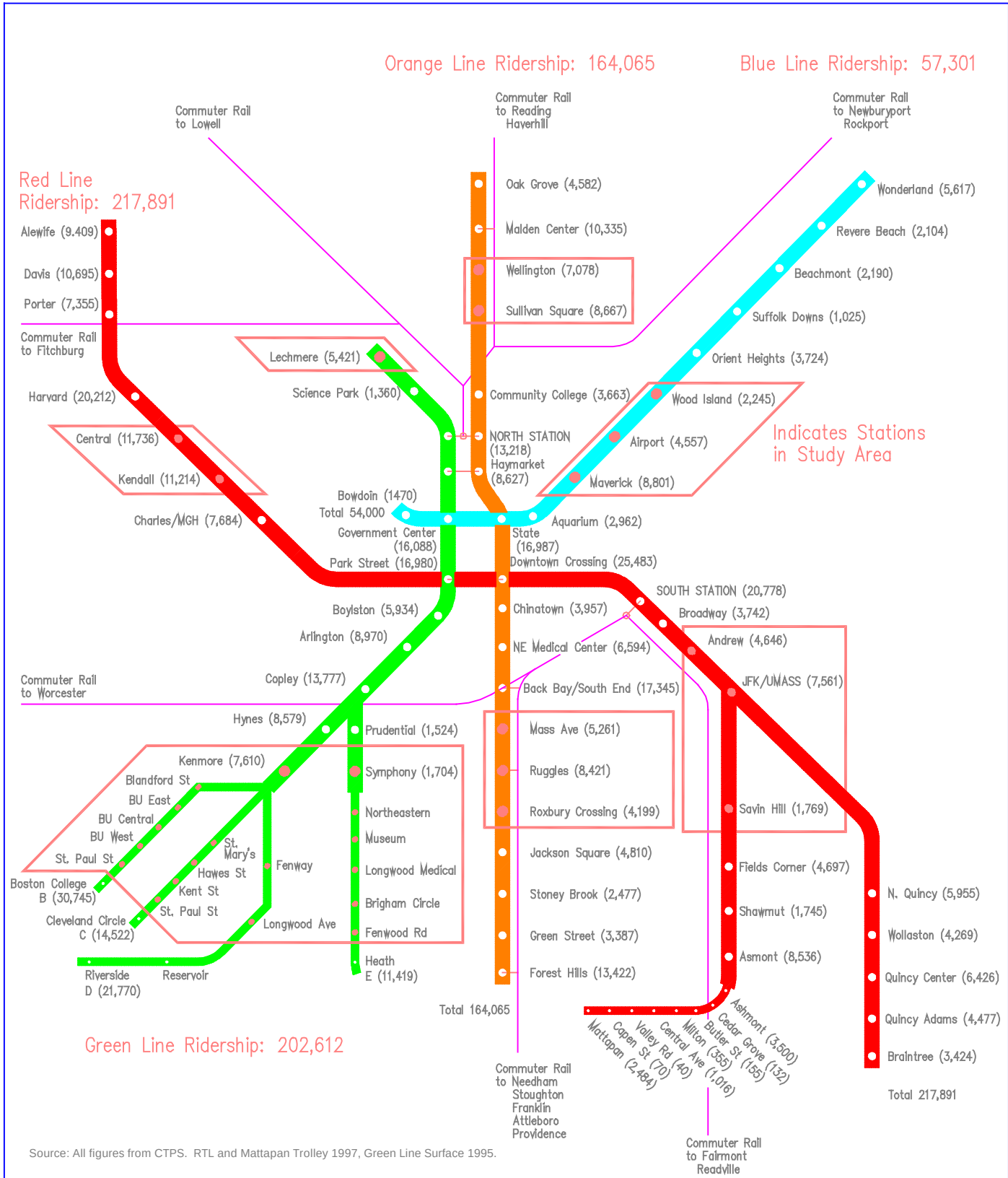
MAY 2001



Not to Scale



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1997 MBTA Rapid Transit System

Daily Boardings and Ridership

JUNE 2001

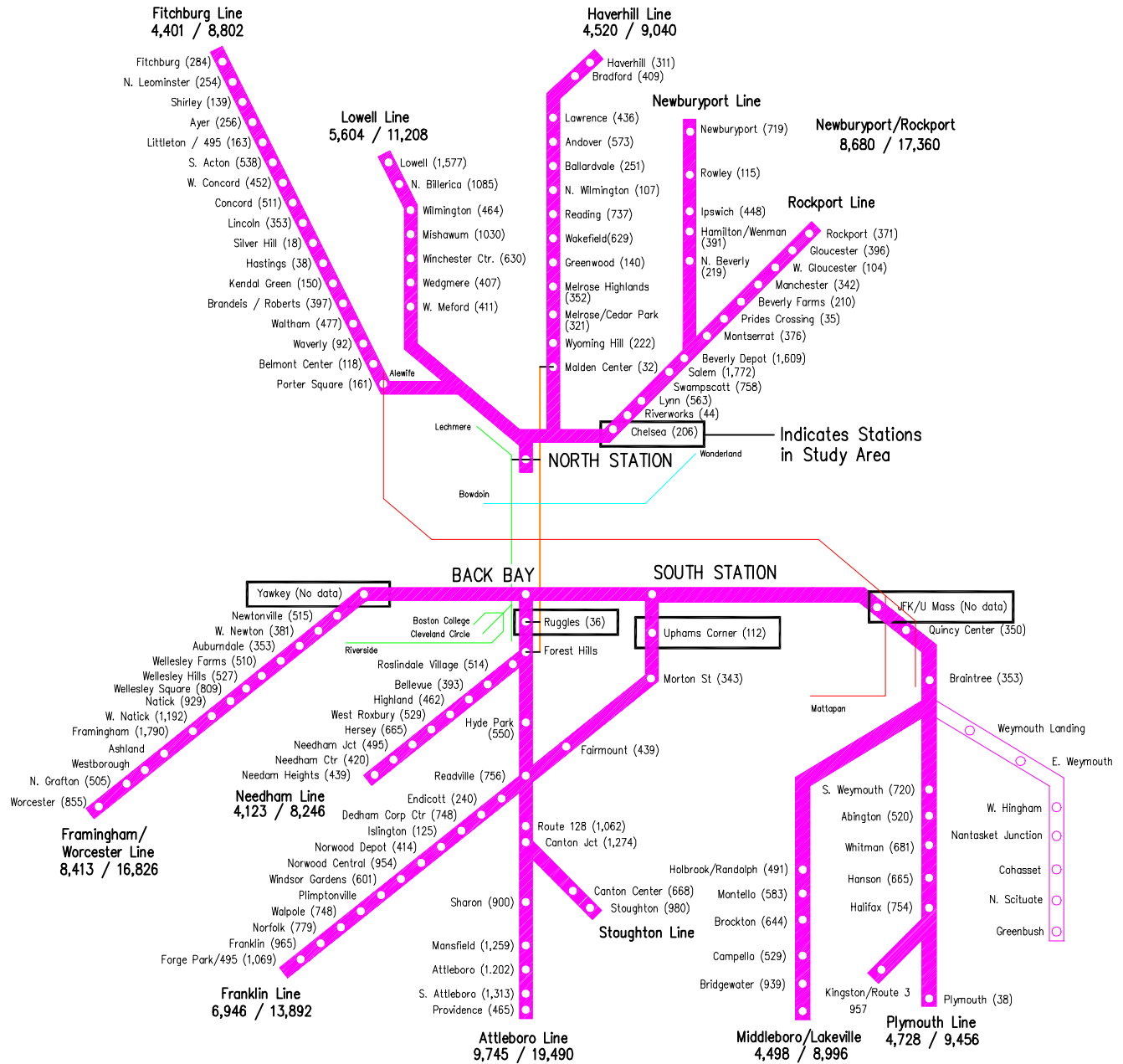


Not to Scale

Figure 2-4



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Note:
Numbers in Parenthesis are Daily Boardings at Individual Stations. The Numbers Listed with Each Line are Total Boardings / Total Daily Ridership. Total Daily Ridership is estimated by doubling total boardings to represent boardings at North Station, South Station and Back Bay, which we have not surveyed.

Source: MBTA Train Audit Thursday June 8, 2000



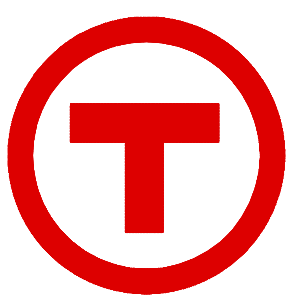
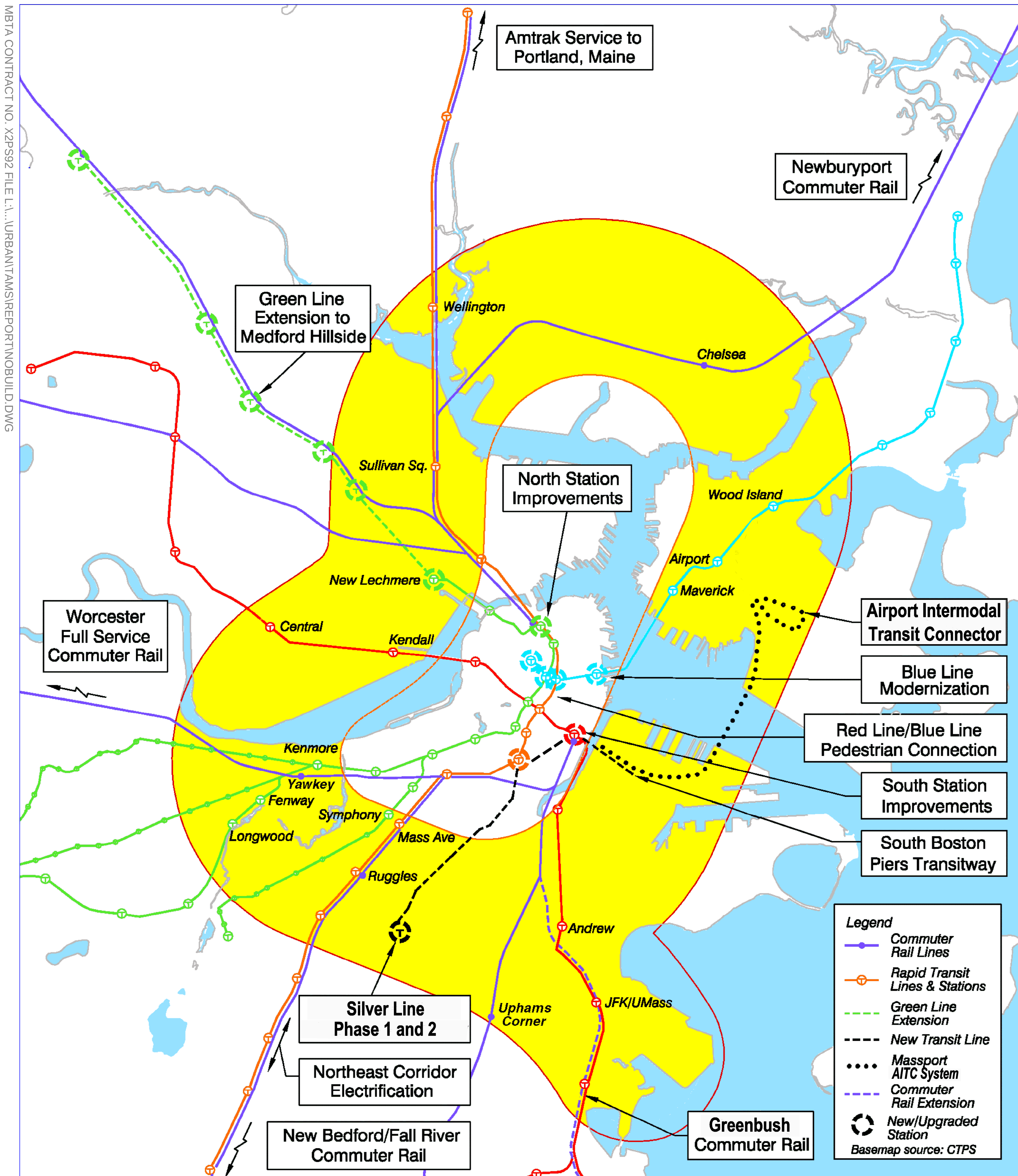
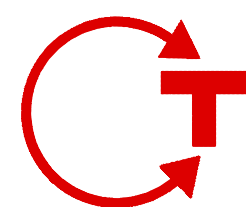
2000 MBTA Commuter Rail System Daily Boardings and Ridership

JUNE 2001



Not to Scale

Figure 2-5



Public Transportation Network

2025 "No Build"

JULY 2001

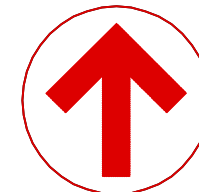


Figure 2-6

Not to Scale

Chapter 3

ALTERNATIVES CONSIDERED

3.0 ALTERNATIVES CONSIDERED

This chapter describes the “No Build,” TSM and range of Alternatives considered in evaluating whether to commit to a major transportation investment to serve the Urban Ring Corridor. An overview of the alternative development process is provided, followed by detailed descriptions of the final alternatives for each of the three phases of the project.

The process began early in the MIS with the analysis of Corridor subareas and was followed by an in-depth description of the development and screening process for fifteen preliminary alternatives, which documents the wide range of solutions considered. The eight Test Alternatives that survived the screening process went on to be defined and tested during 1998. Through a public process of review and input, three Evaluation Alternatives were identified, defined, and evaluated during 1999 and 2000 resulting in development of two lower cost alternatives and the conceptual definition of a three phase implementation plan. This chapter provides a detailed description of the final Phase 1, 2, and 3 alternatives considered for implementation in the Corridor. Refer to the MIS Progress Report dated April 2000 for details pertaining to the Preliminary, Test, and Evaluation alternatives from which the final alternatives were developed.

Based on the findings of the baseline analysis and the adopted project goals and objectives, the Urban Ring alternatives were limited to modes other than single-occupant automobiles. Previous studies had identified and ultimately rejected highway solutions to Corridor access and mobility problems. Therefore, emphasis was placed on developing alternatives focused on public transportation improvements. Recognition was also given to the role of ride sharing, as well as the numerous private transportation services and other activities undertaken by the many Transportation Management Associations (TMA's) present in the Corridor.

The development, refinement and evaluation of the Urban Ring alternatives, consistent with the overall planning process described above, included the following steps:

- Define Linkages
- Preliminary Alternatives
- Screening Process
- Alternatives Development
- Final Alternatives

3.1 Define Linkages

Initially, the Corridor was divided into 20 subareas, aggregations of traffic analysis zones at the subzone level using the CTPS 986 zone system. The mobility needs and desired linkages for each subarea were analyzed, which produced a large number of possible new linkages that were grouped into three categories: local area improvements, connections to other Urban Ring subareas and regional connections.

The need for improved local access to the existing transit network along with access to nearby activities and adjacent subareas was identified. At the local level, the need for higher-frequency transit service not subject to local street congestion was identified. For trips to adjacent subareas, a number of significant patterns emerged. In the northern portion of the Corridor, the need to link Everett and Chelsea to East Boston and Logan Airport on the east and the Wellington Orange Line station on the west were identified. In the central portion of the Corridor, the need to link Somerville, Charlestown and East Cambridge, and to link Cambridge and Somerville to areas south of the Charles River such as the Longwood Medical Area were highlighted. In the southern portion of the Corridor, improving transit connections northward is important to serving both existing land uses, such as the BU Medical Center, and to support development

of emerging areas such as Crosstown/Ruggles, Dudley Square, Uphams Corner and New Market. Equally important, regional access from all Ring subareas to the suburbs was identified as a compelling priority. The Ring would facilitate suburban commutes to Urban Ring destinations and reverse commuting of Corridor residents to employment opportunities in the suburbs. Figure 3-1 depicts many of the key points of interest located around the Corridor as identified early in the study. Figure 3-2 shows the conceptual linkages among these and other key points as identified during the public workshop process and discussions with the Urban Ring Compact jurisdictions.

3.2 Preliminary Alternatives

The next step was to take the desired linkages and formulate Corridor-wide preliminary alternatives. These Corridor-wide options were developed based on four modal/level-of-investment options, two approaches to development of alternatives and the identification of supportive elements, such as commuter rail connections. Figure 3-3 depicts the preliminary alignment options identified early in the study for consideration during the screening process. These preliminary alternatives included a wide range of transit modes, levels of investment, and operating concepts.

3.2.1 Modal/Level-of-Investment Options

The full range of available transit technologies was reviewed based on the ability to meet project goals and objectives, technical feasibility, scale and compatibility with existing and planned transit systems. As a result, the conventional bus system improvements (TSM), Bus Rapid Transit (BRT), Light Rail Transit (LRT) and Heavy Rail Transit (HRT) technologies were identified for further consideration.¹

Generally, the level of capital investment required increases through the range of technology, with TSM being the least capital intensive and HRT being the most capital intensive due to its requirement of 100 percent grade separation and high-level platforms. Within the LRT technology group, two levels of investment were identified. LRT Level 1 maximizes the use of lower-cost, at-grade transit reservation wherever physically possible and limits the use of expensive tunnels and underground stations. LRT Level 2 builds on the LRT Level 1 approach and adds additional sections of tunnel to improve the speed, capacity and efficiency of the LRT operation. The capital requirements of the LRT Level 2 approach are comparable to the capital requirements of HRT approach.

3.2.2 Two Approaches

For each of the modal/level-of-investment options, two approaches to alternative development were used. The first was to apply the given technology from one end of the Corridor to the other, and the second was to apply different technologies in different areas of the Corridor. These two groups were identified as End-to-End Alternatives and Combination Alternatives, respectively.

3.2.3 Supporting Elements

In addition to the Corridor-wide alternatives, several important supporting elements were identified. These improvements fall into the following three categories: new commuter rail stations, existing transit station access improvements to facilitate Urban Ring interface and facilities to support new express bus routes. The supporting elements can be added to any End-to-End or Combination Alternative. Figure 3-4 depicts in general the types of supporting elements identified early in the study from which the specific list of supporting elements, including the new and improved commuter rail stations, were later defined.

¹ Transportation System Management (TSM) is low cost and relies on conventional bus technology operating over new routes and modified versions of existing routes with selected street and intersection improvements. Bus Rapid Transit (BRT) is a high technology, environmentally friendly bus, operating on its own right of way in large segments of the Corridor. BRT technology would be compatible with Silver Line service. Light Rail Transit (LRT) would be Green Line compatible rail service drawing power from overhead catenary wires. Heavy Rail Transit (HRT) would be 100% grade separated, high-platform rail service drawing power from a third rail similar to the existing Orange Line.

The process described above resulted in the identification of 15 preliminary Corridor-wide alternatives and three packages of supporting elements that can be combined within any of the Corridor-wide options.

3.3 Screening Process

A screening process to identify fatal flaws and other serious problems was applied to the 15 preliminary Corridor-wide alternatives at one of the early Urban Ring Workshops. The purpose of this effort was to reduce the long list of alternatives to a more manageable number for more detailed descriptions and evaluation. The key screening criteria included:

- Environmental constraints
- Markets served and projected ridership
- Estimated costs
- Compatibility with the existing MBTA system
- Physical constraints
- Phasing potential
- Redundancy

The screening process eliminated nearly half of the preliminary alternatives, primarily for reasons of system incompatibility, poor phasing characteristics, and redundancy with other alternatives or cost. Alternatives that emerged from the screening process were further refined with sufficient detail so that they could be carried forward into the alternatives evaluation and refinement.

3.4 Alternatives Development

The viable preliminary alternatives, including TSM, were developed in greater detail and evaluated through a process of reporting and feedback with the Urban Ring technical committees. The range of alternatives consisted of:

- “No Build” Alternative
- TSM Alternative
- End-to-End and Combination Alternatives

3.4.1 “No Build” Alternative

This alternative represents the transportation system in Greater Boston that is expected to be in place in the year 2025 in the absence of any Urban Ring improvements. Sometimes referred to as the “Do-Nothing” Alternative, it is comprised of the existing MBTA system with the addition of all the projects contained in the 2025 Regional Transportation Plan, as discussed in Chapter 2. The “No Build” alternative provides a reference point against which the benefits and costs of the Urban Ring TSM and various End-to-End and Combination Alternatives are compared. The projected transportation networks were also defined for the years 2003 and 2010. Urban Ring alternatives would be added to the projected 2003, 2010, and 2025 networks.

3.4.2 TSM Alternative

The TSM Alternative represents a relatively low level of investment and, like the “No Build,” are required as a point of comparison against which the benefits and costs of the more capital-intensive “Build” Alternatives must be compared at each phase of the project. The TSM Alternative developed for Phase 1 of the Urban Ring is comprised of the following new and improved conventional bus routes:

- New Express Commuter (EC) bus routes
- New crosstown (CT) bus routes
- Modifications to existing CT bus routes
- Basic bus service improvements

The non-redundant routes would continue to operate in support of the Phase 2 and Phase 3 alternatives. There are two additional TSM alternatives for the years 2010 and 2025 consisting of the Phase 1 TSM alternative with the transportation networks in place at those points in time.

3.4.3 End-to-End and Combination Alternatives

The end-to-end alternatives consisted of a single transit technology, while different technologies in segments of the Corridor were considered for the combination alternatives. The alternatives development, screening, and evaluation process is summarized in the diagram contained in the Executive Summary Figure S-4. The alternatives were developed through an iterative process from those surviving the preliminary alternatives analysis. The surviving end-to-end alternatives consisted of a single technology, either BRT or LRT, from East Boston on the north end of the Corridor to JFK/UMass on the south end of the Corridor. The surviving combination alternatives consisted of rail in the most densely traveled portion of the Corridor between the Orange Line at Assembly Square and the Orange Line at Ruggles, with overlapping BRT routes serving the northern, southern and eastern portions of the Corridor.

All of these alternatives would require significant capital investment. Some additional consolidation and definition occurred early in their development following the fatal flaw screening process based on input from other Workshops and technical subcommittees. Each of the alternatives was then defined to an equivalent level of detail, including development of a conceptual operating plan and a set of 1"=200' scale plan and profile drawings to enable analysis and comparison of such measures as ridership, costs and environmental consequences.

Each of these alternatives included a tunnel under the Charles River, either near the BU Bridge/Park Drive or Kenmore Square. The Light Rail alternatives feature an alignment and operating plan that interlines with the Green Line Extension at New Lechmere. The Heavy Rail alternative features an alignment and operating plan that interlines with the Orange Line at Sullivan Square.

The analysis of the various end-to-end and combination alternatives resulted in several significant findings that would lead to further narrowing of the alignments and technology. The analysis showed that the end-to-end BRT Alternative would not adequately reduce radial transit congestion and would have the most limited capacity relative to cost. The analysis also showed that all the end-to-end rail alternatives exhibited much lower cost effectiveness than the combination alternatives consisting of rail in the most heavily traveled portion of the Corridor between Assembly Square and Dudley Square, with overlapping BRT routes serving the northern and southeastern portions of the Corridor.

One of the combination alternatives that followed the available Grand Junction railroad right-of-way between Main Street and Gore Street in East Cambridge was strongly opposed by the City of Cambridge because it would not directly serve the growing corridor between Kendall Square and New Lechmere. Because of strong benefits in other areas, options for modifying this mostly at-grade LRT alternative to directly serve Kendall Square and New Lechmere were explored in conjunction with the City of Cambridge. The remaining combination alternatives were presented and discussed with stakeholders and modified to incorporate and further examine certain features from the earlier alternatives. Figure 3-5 contains a flow chart representing the steps involved in reaching the identified final alternatives.

3.5 Final Alternatives

The final alternatives resulting from the development process consist of a revised TSM Alternative and two versions of Light Rail Transit (LRT) and one version of Heavy Rail Transit (Heavy Rail) in combination with Bus Rapid Transit (BRT), supporting elements, and the non-redundant Crosstown and Express

Commuter bus routes. All BRT routes in the final alternatives are consistent and compatible with the MBTA's current plans for the Silver Line. The 2025 "No Build" Alternative identified previously was unchanged and remained the point of comparison. The following paragraphs and referenced figures and tables at the back of this report provide a detailed description of the final Phase 1, 2, and 3 alternatives considered for implementation in the Corridor.

Each of these alternatives would be developed in three phases:

- Phase 1 (2001 - 2005): TSM
- Phase 2 (2006 - 2010): TSM + BRT and Supporting Elements
- Phase 3 (2010 - 2015): TSM + BRT and Supporting Elements + Rail Transit

The sole difference between the alternatives occurs in Phase 3 and regards the rail alignment, profile, and technology. Phase 1 and Phase 2 can be implemented independent of that decision, and Phase 1 is separable from, and could proceed independently from, both Phases 2 and 3. Phase 3 provides a choice between an all-tunnel Urban Ring rail system crossing the Charles River in a tunnel at Kenmore Square that could accommodate either Light Rail (Alternative A1) or Heavy Rail (Alternative A2) technology, or a partially at-grade Light Rail system north of the Charles River with a tunnel crossing near BU/Park Drive (Alternative B).

In Phase 1, TSM elements, (aka improved bus service) not requiring major new construction would be implemented.

In Phase 2, Bus Rapid Transit (BRT) routes and supporting elements such as commuter rail stations at Urban Ring interfaces would be constructed and implemented. A fleet of BRT vehicles would be purchased, and an additional BRT vehicle maintenance facility capacity provided. The TSM bus routes from Phase 1 would continue where not redundant to the BRT service. The BRT routes would operate at frequencies comparable to existing transit lines with station stops as shown on the diagram. During Phase 2, the environmental filings are made for the subsequent Urban Ring rail system of Phase 3.

In Phase 3, an Urban Ring rail service between Assembly Square in Somerville and Dudley Square in the Roxbury neighborhood of Boston would be constructed and implemented. A fleet of electric powered rail transit vehicles would be purchased, and an additional rail transit vehicle maintenance facility capacity provided. The TSM, BRT and supporting elements of Phase 1 and 2 would continue where not redundant to the Phase 3 Urban Ring rail service. The route and technology alternatives for implementation of the Phase 3 Urban Ring rail service are summarized below.

<u>Phase 3 Alternative</u>	<u>Description</u>
A1 and A2	Cross the Charles River in tunnel at Kenmore Square, follow the shortest route, and require the fewest stations to connect with the MBTA's radial lines. The gentler curves of the all-tunnel alignment allow the choice of either Light Rail (Alternative A1) or Heavy Rail (Alternative A2) transit technology.
B	Crosses the Charles River near the B.U. Bridge and Park Drive and follows a longer route requiring more stations to connect with the MBTA's radial lines. In order to offset the costs of the longer route and additional stations, use of surface alignments is maximized in Somerville and Cambridge. Use of Light Rail is required in order to handle tight turns and operate within and across street traffic.

3.5.1 Phase 1 - Improved Bus Service

Phase 1 consists of a significant expansion in the number and reach of the Crosstown (CT) bus routes, and the addition of new Express Commuter (EC) service to provide single seat radial and crosstown service from suburban locations into the Corridor. The Phase 1 bus routes considered in the final evaluation are described below and depicted in Figure 3-6. Phase 1 bus routes will utilize 40-foot, low-floor, CNG powered buses similar to the example shown in Figure 3-7.

All the EC routes will operate similar to existing MBTA Express Bus service (including “reverse direction” service). There are a total of 11 CT routes consisting of modifications to three existing CT routes and the addition of eight new CT routes. The CT routes will operate similar to existing MBTA CT limited-stop service connecting rapid transit nodes and major activity. Tables 3-1, 3-4, and 3-5 summarize the operating characteristics of the Phase 1 bus routes.

The route descriptions provided below list the bus stops (underlined) and the streets followed by the route between each bus stop.

3.5.1.1 Express Commuter (EC) Route Descriptions

All proposed routes would operate similar to existing MBTA Express Bus service (including “reverse direction” service) with 12-minute headways.

- | | |
|------------|--|
| EC1 | Woburn Intermodal Center to University Park in Cambridge via Sullivan Square and Lechmere. This route as originally defined terminated at Kendall/MIT. Sensitivity analysis was then performed that showed ridership would grow significantly if the route were extended to University Park. |
| Route: | <u>Woburn/Mishawum</u> (relocated), I-93, Mystic Avenue, <u>Sullivan Station</u> , Washington Street, McGrath Highway, Msgr. O'Brien Highway, <u>Lechmere Station</u> , First Street, Binney Street, Broadway, Main Street, <u>Kendall/MIT Station</u> , Main Street, Massachusetts Avenue, <u>University Park</u> . |
| EC2 | Riverside to Lechmere via Newton Corner, Allston Landing, Central Square and Kendall Square. |
| Route: | <u>Riverside Station</u> , Grove Street, Route 128, I-90, <u>Newton Corner</u> , I-90, Allston interchange, <u>Allston Landing</u> (TBD), River Street (inbound)/Western Avenue (outbound), <u>Central Station</u> , Massachusetts Avenue, Main Street, Broadway, Main Street, <u>Kendall/MIT Station</u> , Binney Street, First Street, <u>Lechmere Station</u> . |
| EC3 | Route 9 Natick to Kenmore Square via Wellesley Hills, Riverside, Newton Corner and Longwood Medical Area. (As discussed later in Chapter 4, projected ridership for the EC3 route is very low and it was agreed that the EC3 route is not recommended for implementation.) |
| Route: | <u>Route 9 Natick</u> , <u>Wellesley Hills</u> , <u>Riverside Station</u> , Grove Street, Rte. 128, I-90, <u>Newton Corner</u> (Center Street), I-90, Copley/Back Bay interchange, Huntington Avenue, Louis Prang Street, Fenway, Avenue Louis Pasteur, <u>Longwood Medical Area</u> , Longwood Avenue, Brookline Avenue, <u>Kenmore Station</u> |

3.5.1.2 Modified Crosstown (CT) Bus Routes

All routes would operate similar to existing MBTA Crosstown (CT) limited-stop service connecting rapid transit nodes and major activity centers with assumed 10-minute peak period headways and 20-minute off-peak headways.

CT1 Central Square to Andrew Station via Massachusetts Avenue.

Route: Central Square, Massachusetts Avenue, University Park, MIT, Hynes/ICA, Symphony, Massachusetts Avenue, Silver Line/Washington Street, City Hospital/BU Medical Area, Southampton Street, Newmarket/South Bay, Andrew Station.

The existing CT1 route, which currently terminates at the Boston Medical Center, would be modified by extending it further east to Andrew Station on the Red Line. This extension will increase the geographic reach of single-seat rides on the CT1 and will connect this crosstown bus route with an additional radial transit line. This modification also enables the CT3 route to be streamlined as described below.

CT2 Sullivan Square to LMA via Union Square and Kendall.

Route: Sullivan Station, Washington Street, Union Square, Webster Avenue, Cambridge Street, Columbia Street, Hampshire Street, Kendall/MIT Station, Broadway (inbound)/Main Street (outbound), Vassar Street, MIT/MassAve, Amesbury, Memorial Drive, BU Bridge, Boston University, Mountford Street, Park Drive, Fenway, Brookline Avenue, Longwood Avenue, Longwood Medical Area

The CT2 route was extended northward from Kendall/MIT to Sullivan Square via Union Square, as defined by this study, during the course of the Urban Ring MIS. Other modifications identified for Phase 1 of the Urban Ring include increased frequency of service and more efficient routing through major activity centers such as the Longwood Medical Area and Kendall/MIT.

CT3 Longwood Medical Area to Logan Airport via Bio Square.

Route: LMA, Fenway, Louis Prang Street, Green Line/Museum, Ruggles Street, Ruggles Station, Melnea Cass Boulevard, Washington Street/Silver Line Station, Albany Street, Bio Square, South Boston Bypass, Convention Center, Ted Williams Tunnel, Logan Airport, Airport Blue Line Station.

The existing CT3 route would be modified to reduce overall trip times on what is now one of the longest routes in the system. Existing travel times on this route during peak hour are lengthy and user perception of delay is worsened by the existing stop at Andrew on the Red Line. Extending the CT1 route to Andrew Station as described above preserves crosstown service at Andrew while enabling the CT3 route to bypass Andrew, thereby reducing travel time and improving schedule adherence on the CT3.

As defined, the Phase 1 CT3 route would continue to operate over the South Boston Haul Road as it does today. However, based on environmental permitting governing use of that facility, upon completion of the Central Artery Project the Haul Road may be restricted to trucks only and may no longer be available to buses. An alternate route for the CT3 to reach the South Boston Waterfront and Williams Tunnel would be the HOV lanes within the final design of the Southeast Expressway. Issues associated with that option are discussed in the Phase 2 paragraph under the BRT7 route.

3.5.1.3 New Crosstown (CT) Bus Routes²

CT4 Ruggles Station to JFK/UMass via Dudley Square and Uphams Corner.

² In Phase 1 the proposed CT3, CT4 and CT5 routes would serve locations currently served by non-MBTA shuttle bus operators. Implementation of Phase 1 service in such locations will need to address issues of vehicle purchase, operating subsidy, 13(c) indemnification, and indemnification of competition claims from current shuttle contractors.

- Route:* Ruggles Station, New Dudley Street (outbound)/Ruggles Street (inbound), Dudley Square, Dudley Street, Hampden Street, Uphams Corner, Columbia Road, Edward Everett Square, JFK/UMass.
- CT5** Logan Airport to Sullivan Square via Chelsea and Everett.
- Route:* Logan Airport Terminals, Airport Blue Line Station, Route 1A, Wood Island Station, Chelsea Street, Chelsea Street Bridge, Massport Chelsea Garage, Central Avenue, Chelsea Downtown, Washington Avenue/Broadway, Chelsea Commuter Rail/Bellingham Square, Everett Avenue, Mystic Mall/Triangle, Everett Avenue, Revere Beach Pkwy., Revere Beach Parkway, Second Street, Broadway, Wellington, Fellsway, Assembly Square, Sullivan Square Station.
- CT6** Chelsea to Kendall Square via Community College and Lechmere.
- Route:* Bellingham Square (Chelsea Commuter Rail connection), Third Street ramp (outbound)/ Beacon Street ramp (inbound), Tobin Bridge, City Square interchange, Rutherford Avenue, Gilmore Bridge, Msgr. O'Brien Highway, Lechmere Station, First Street, Binney Street, Broadway, Main Street, Kendall/MIT Station.
- CT7** Kendall Square to Franklin Park/Grove Hall via Kenmore Sq., Ruggles, and Dudley.
- Route:* Kendall/MIT Station, Vassar Street, Massachusetts Avenue, MIT, Harvard Bridge, Beacon Street/Bay State Road/Sherborn Street/BU:Blandford Street/Commonwealth Avenue (outbound) / Commonwealth Avenue/Massachusetts Avenue (inbound), Kenmore Station, Brookline Avenue/Longwood Avenue, Longwood Medical Area, Huntington Avenue, Green Line/Museum, Ruggles Street, Ruggles Station, New Dudley Street (outbound)/Ruggles Street (inbound), Dudley Square, Dudley Street, Warren Street, Humboldt, Blue Hill Avenue, Grove Hall, Franklin Park Zoo.
- CT8** Sullivan Square to Longwood Medical Area via Union Square, University Park, Lower Cambridgeport and Boston University.
- Route:* Sullivan Station, Washington Street, Union Square, Somerville Avenue/Webster Avenue (outbound) / Prospect Street (inbound), Webster Avenue, , Cambridge Street, Columbia Street, University Park/Lafayette Square, Sidney Street (outbound) / Waverly Street/Albany Street/Massachusetts Avenue (inbound), Lower Cambridgeport (TBD), Henry Street, Prospect Street, BU Bridge, Boston University, Mountford Street, Park Drive, Fenway/Avenue Louis Pasteur (inbound) / Longwood Avenue/Brookline Avenue (outbound) Longwood Medical Area
- CT9** Kenmore Square to Harvard Square via Boston University and Allston Landing.
- Route:* Kenmore Station, Commonwealth Avenue, Boston University (at BU Bridge), Commonwealth Avenue, Packards Corner, Brighton Avenue, Harvard Avenue, Cambridge Street, Allston Landing (TBD), Route TBD, Western Avenue, North Harvard Street, Larz Anderson Bridge, JFK Street, JFK Street (inbound) / Brattle Street/Mount Auburn Street (outbound), Harvard Station

- CT10** Kenmore Square to JFK/UMass via Longwood Medical Area, MFA, Ruggles, Washington St/Silver Line, City Hospital, BU Medical Area, Newmarket/South Bay and Andrew.
- Route: Kenmore Station, Brookline Avenue/Longwood Avenue/Avenue Louis Pasteur, Longwood Medical Area, Fenway, Louis Prang Street, Green Line/MFA Station, Ruggles Street, Ruggles Station, Melnea Cass Boulevard, Washington Street/Silver Line Station, Harrison Avenue, City Hospital, East Concord Street (outbound) / East Newton Street (inbound), BU Medical Area, BioSquare connector, Southeast Expressway, JFK/UMass Station
- CT11** Longwood Medical Area to Fields Corner via MFA, BU Medical, and Uphams Corner.
- Route: Longwood Medical Area, Louis Pasteur(outbound)/Huntington (inbound), Fenway, Louis Prang, Museum of Fine Arts, Ruggles Street, Melnea Cass Boulevard, Washington Street/Silver Line Station, Harrison Avenue, City Hospital, East Concord Street (outbound) / East Newton Street (inbound), BU Medical Area, Albany Street, Hampden Street, Dudley Street, Uphams Corner, Dudley Street, Columbia Road, Hancock Street, Kane Square, Bowdoin Street, Geneva Avenue, Fields Corner

3.5.1.4 Bus Fleet Size

The number of buses needed to operate the Phase 1 EC and CT routes was calculated using the length of the route, the peak period headways, and the assumed average speed of the route including all stops (approximately 12mph). For example: A route that is 6 miles long in each direction requires 12 miles per round trip. At an average speed of 12mph that would take 60 minutes per complete cycle, exclusive of recovery time. Using 10 minute headways would require 6 buses on this route to provide the planned level of service. The two new EC routes being proposed, while long, operate at 12 minute peak headways, have higher average speeds, and require fewer buses per route mile than does the CT routes.

The three existing CT routes (CT1, CT2, CT3) already have vehicles but Phase 1 will double the frequency in the peak period from every 20 minutes to every 10 minutes. Therefore, for those routes it is assumed that the number of new buses needed would be half of what a comparable new route would require. The estimated number of new buses required to operate the proposed Phase 1 bus routes is 10 each for the two new EC routes plus 55 for the CT routes for a total of 75 buses. It is assumed that another 33% will be needed for spares which amounts to 25 additional buses. The percentage of spares is higher than used for diesel buses because CNG buses are currently less reliable than diesel buses. The total estimated fleet size needed, including spares is 100 buses.

3.5.2 Phase 2 – Bus Rapid Transit Service and Supporting Elements

Phase 2 builds upon the EC and CT bus routes of Phase 1 by adding seven Bus Rapid Transit (BRT) routes throughout the Corridor. Some of the BRT routes in Phase 2 are new, and others are modified or upgraded versions of the Phase 1 bus routes. A total of seven BRT routes are provided in Phase 2, as described below and depicted in Figure 3-8. Phase 2 BRT routes will utilize 60' articulated low-floor, low-emission vehicles, segments of exclusive busway, ITS features, and supporting elements to improve connections with radial transit and commuter rail lines. The BRT vehicles will be similar to the example shown in Figure 3-9. The operating characteristics of the BRT service are summarized in Tables 3-2, 3-4, and 3-5.

The paragraphs below summarize the changes to the Phase 1 service that occurs in Phase 2 and provides a list of the Phase 2 supporting elements such as new and improved commuter rail stations. Also provided is a detailed description of each of the seven routes and general description of the station location.

3.5.2.1 Changes to Phase 1 Routes Occurring in Phase 2

Five of the Phase 1 bus routes (CT2, CT3, CT4, CT5, CT8) are converted to Bus Rapid Transit service in Phase 2. One of the EC routes (EC1) is dropped because it becomes redundant to a new Commuter Rail/BRT connection at Sullivan Square, and the CT11 route is modified to follow the former CT4 route north of Dudley/Hampden corner to provide better coverage in tandem with the new BRT routes.

3.5.2.2 Supporting Elements: New or Expanded Commuter Rail Stations

As documented in Chapter 2, the MBTA's extensive commuter rail system still lacks station stops within the Corridor on several of its lines, and most of the existing stations within the Corridor lack quality transit connections for crosstown trips. Suburban commuters bound for employment centers located within the Urban Ring Corridor often must take commuter rail past their actual destination all the way into North or South Station and transfer to a radial transit line for a trip back out to the Urban Ring Corridor. The MBTA has recently taken steps to address this problem with the institution of full-time commuter rail service at the Yawkey Station near Fenway Park and Longwood Medical Area, as well as the opening of a new commuter rail station on the Old Colony Line at JFK/UMass. However, while radial transit connections are good at these locations, reliable distribution of these trips along the crosstown Corridor remains a challenge using conventional buses on existing streets. Similarly, access from Corridor neighborhoods to commuter rail to reach suburban locations in a reverse commute pattern is also difficult.

In Phase 2, the Urban Ring would build upon the considerable investments already made by the MBTA in its commuter rail system by providing the following new or improved facilities that will enable convenient transfers between commuter rail and the Urban Ring services:

Downtown Chelsea:	Expand and improve existing station on the Newburyport/Rockport Line
Sullivan Square:	New station stop near junction of the Newburyport/Rockport and Haverhill Lines
Gilman Square:	New station stop on the Lowell Line
Union Square:	New station stop on the Fitchburg Line
Yawkey:	Expand and improve existing station on the Framingham/Worcester Line
Ruggles:	Expanded stop with platforms on both sides of Northeast Corridor
Uphams Corner:	Improved stop on the Fairmont Line

3.5.2.3 BRT Service Frequency

Each of the BRT routes will have all day service with the following headways:

- 10 minute Morning/Evening peak headway
- 15 minute Midday/Saturday headway
- 20 minute Evening/Sunday/Holiday headway

Where routes overlap in portions of the Corridor the effective headways for BRT service between many stations will be more frequent than shown. The BRT routes will operate over a combination of separate rights-of-way and mixed traffic, utilizing Intelligent Transportation System (ITS) features to improve performance and passenger information.

3.5.2.4 BRT Route Descriptions and Stations³

There are a total of seven Urban Ring BRT routes in Phase 2 which together provide service throughout the 15-mile long corridor. Several of the routes overlap, particularly in the most heavily traveled portions of the Corridor. Table 3-6 contains a listing of the Phase 2 and Phase 3 stations, the municipality in which they would be located, and the intermodal connections that would be available to them. A summary list of the

³ In Phase 2 the proposed BRT1, BRT2 and BRT6 routes would serve locations currently served by non-MBTA shuttle bus operators. Implementation of Phase 2 service in such locations will need to address issues of vehicle purchase, operating subsidy, 13(c) indemnification, and indemnification of competition claims from current shuttle contractors to the extent that they have not already been resolved in Phase 1.

seven routes is provided below followed by a full description of each route with an identification of each BRT station.

- BRT1 Logan Airport Terminals to Kendall Square
- BRT2 Logan Terminals to Wellington
- BRT3 Wellington to Kendall Square
- BRT4 Riverside to Kendall Square
- BRT5 New Lechmere to Longwood Medical Area
- BRT6 Longwood Medical Area to UMass Campus
- BRT7 Longwood Medical Area to Airport Blue Line Station

BRT1 Logan Airport Terminals to Kendall Square via Wellington, Assembly Square, Sullivan Square and New Lechmere.

Route: Logan Airport Terminal, Terminal Roadways, Airport Blue Line Station, East Boston BRT/Truck Route (new), Chelsea Street, Chelsea Creek Bridge, BRT Busway (new), Downtown Chelsea/Commuter Rail, BRT Busway (new), Everett Avenue/Mystic Mall, Everett Avenue, Chelsea HS, Revere Beach Parkway, Second Street, Revere Beach Parkway, Broadway, Revere Beach Parkway, Wellington, Fellsway, Assembly Square, Mystic Avenue, Sullivan Square, Rutherford Avenue Bypass (new), Gilmore BRT Busway (new), New Lechmere, First Street, Cambridgeside Galleria, First Street, Binney Street, Second Street, Third Street, Kendall/MIT.

The proposed BRT1 route would provide local service with a single seat ride across the entire northern portion of the Corridor from Logan Airport through Chelsea, Everett, Wellington, Somerville, and Cambridge. There are 14 station stops planned along this 10-mile long route. Three segments of the route totaling approximately 3 miles would operate over exclusive or semi-exclusive rights-of-way.

- Airport Blue Line Station to Chelsea Creek in East Boston
- Chelsea Creek through East Chelsea to Everett Avenue in Chelsea
- Rutherford Avenue to New Lechmere in Charlestown and Cambridge

The balance of the BRT1 route would operate in bus lanes and mixed traffic facilitated by ITS features to be defined during the environmental process for Phase 2.

BRT2 Logan Airport Terminals to Wellington with Limited Stops via Revere Beach Parkway.

Route: Logan Airport Terminal, Terminal Roadways, Airport Blue Line Station, East Boston BRT/Truck Route (new), Chelsea Street, Chelsea Creek Bridge, BRT Busway (new), Downtown Chelsea/Commuter Rail, BRT Busway (new), Everett Avenue/Mystic Mall, Everett Avenue, Revere Beach Parkway, Wellington.

The proposed BRT2 route would provide express service across the northern portion of the Corridor providing rapid connections between Logan Airport on the east and Wellington on the west with only limited stops in between where its route overlaps the BRT1 service. There are 5 station stops planned along this 6-mile long route. Two segments of the route totaling approximately 2.5 miles would operate over exclusive or semi-exclusive rights-of-way.

- Airport Blue Line Station to Chelsea Creek in East Boston
- Chelsea Creek through East Chelsea to Everett Avenue in Chelsea

The balance of the BRT2 route would operate in bus lanes and mixed traffic facilitated by ITS features to be defined during the Phase 2 environmental process.

BRT3 Wellington to Kendall Square via Union Square.

Route: Wellington, Fellsway/O'Brien Highway, Pearl Street, Gilman Square, Medford Street, O'Brien Highway, Somerville Avenue, Union Square, BRT Busway adjacent to north side of Fitchburg commuter rail line (new), O'Brien Highway, New Lechmere, First Street, Cambridgeside, Binney Street, Second Street, Third Street, Kendall/MIT.

The proposed BRT3 route would provide service aimed at connecting the East Somerville activity centers of Union Square, Gilman Square, and Assembly Square with each other, and with the radial transit and commuter rail lines and activity centers to the north and south. There are 6 station stops planned along this 5-mile long route. One segment of the route totaling approximately a mile would operate over exclusive or semi-exclusive rights-of-way.

- Union Square to New Lechmere

The balance of the BRT3 route would operate in bus lanes and mixed traffic facilitated by ITS features to be defined during the Phase 2 environmental process.

BRT4 Riverside to Kendall Square via MassPike Bus Ramp.

Route: Riverside, Massachusetts Turnpike (I-90), MassPike Bus Ramp (new), BRT Busway across Grand Junction Charles River Bridge (modified), BRT Busway along Grand Junction (new), Cambridgeport, BRT Busway along Grand Junction (new), MIT/MassAve, BRT Busway along Grand Junction (new), Main Street, Mid-Block Connector, Broadway, Kendall/MIT.

The proposed BRT4 route would provide a single seat ride between suburban locations near the junction of Route 128/MassTurnpike and employment centers in East Cambridge featuring an exclusive busway connection between the MassPike and East Cambridge. There are 7 station stops planned along this 11-mile long route. One segment of the route totaling approximately a mile would operate over exclusive or semi-exclusive rights-of-way by modifying the Grand Junction Railroad bridge over the Charles River to include a busway and using a portion of the Grand Junction right-of-way through the MIT campus.

- MassPike to Main Street East Cambridge along the Grand Junction right-of-way

Alternatively, the route may follow Vassar Street between Cambridgeport and Main Street in Cambridge rather than the Grand Junction alignment that was the basis of the ridership forecasting presented in this report. The specific alignment is to be determined during the Phase 2 environmental process. The balance of the BRT4 route would operate in bus lanes and mixed traffic facilitated by ITS features.

BRT5 New Lechmere to Longwood Medical Area via BU/Park Drive.

Route: New Lechmere, First Street, Cambridgeside Galleria, First Street, Binney Street, Second Street, Third Street, Main Street, Kendall/MIT, Main Street, BRT Busway along Grand Junction (new), MIT/Mass Avenue, BRT Busway along Grand Junction (new), Cambridgeport, BRT Busway along Grand Junction (new), BRT Busway across Grand Junction Charles River Bridge (modified), BRT Busway Tunnel under MassPike (new), Mountfort Street, BU/St. Mary's Street, Park Drive, Green Line D/Fenway, Sears Rotary, Fenway, Emmanuel, Avenue Louis Pasteur, Longwood Medical Area.

The proposed BRT5 route would provide a single seat ride in one of the most heavily traveled portions of the Corridor linking activity centers and neighborhoods on the north and south sides of the Charles River. It will supersede the Phase 1 CT2 route and provide travel time advantages through use of the Cambridge busway and Charles River bridge described in BRT4, as well as a busway tunnel beneath the MassPike connecting the Charles River Bridge to Mountfort Street and Park Drive in Boston. There are 10 station stops planned along this 4-mile long route. Two segments of the route totaling approximately 1-1/2 miles would operate over exclusive or semi-exclusive rights-of-way by modifying the Grand Junction Railroad bridge over the Charles River to include a busway and using a portion of the Grand Junction right-of-way through the MIT campus, the tunnel under the MassPike, and implementation of a contra-flow bus lane along the Fenway.

- Main Street East Cambridge to Mountfort/Park Drive in Boston
- Fenway contra-flow bus lane

As mentioned in BRT4, the route may follow Vassar Street between Cambridgeport and Main Street in Cambridge rather than the Grand Junction alignment that was the basis of the ridership forecasting. The specific alignment is to be determined during the Phase 2 environmental process. The balance of the BRT5 route would operate in bus lanes and mixed traffic facilitated by ITS features.

BRT6 Longwood Medical Area to UMass Campus via Uphams Corner.

Route: Longwood Medical Area, Longwood Avenue, Brookline Avenue, Beth Israel Hospital, Fenway, Louis Prang, Green Line E, Ruggles Street BRT Busway (new), Ruggles, Melnea Cass BRT Busway (new), Silver Line at Washington Street, Melnea Cass BRT Busway (new), Harrison Avenue, City Hospital, Harrison Avenue, East Concord Street, Biosquare, Albany Street, Crosstown, Hampden Street, Blue Hill Avenue, Dudley Street, Uphams Corner, Columbia Road, Edward Everett Square, Columbia Road, JFK/UMass, Morrissey Boulevard, UMass Campus.

The proposed BRT6 route would provide a single seat ride linking activity centers and neighborhoods in Roxbury/Dorchester with the educational, retail, and employment opportunities of UMass to the east, Crosstown/City Hospital to the north, and Northeastern/Wentworth and Longwood Medical Area to the northwest. It also links these neighborhoods to every existing and planned radial transit and commuter rail line located between these points thereby providing connectivity to the entire MBTA system. There are 11 station stops planned along this 6-mile long route. Two segments of the route totaling approximately a mile would operate over exclusive or semi-exclusive rights-of-way.

- Ruggles Street busway between Huntington Avenue and Ruggles
- Melnea Cass Boulevard busway between Ruggles and Harrison Avenue

Additionally, some short segments of exclusive busway may be implemented at Uphams Corner to enable the BRT vehicles to avoid congestion at locations such as the corner of Dudley Street and Columbia Road. The specific alignment is to be determined during the Phase 2 environmental process. The balance of the BRT5 route would operate in bus lanes and mixed traffic facilitated by ITS features.

BRT7 Longwood Medical Area to Airport Blue Line Station via South Boston and Williams Tunnel.

Route: Longwood Medical Area, Avenue Louis Pasteur, Emmanuel, Fenway, Louis Prang, Green Line E, Ruggles Street BRT Busway (new), Ruggles, Melnea Cass BRT Busway (new), Silver Line at Washington Street, Melnea Cass BRT Busway (new), Albany Street, Crosstown, Albany Street, Biosquare, BRT Connector Road, Mass Avenue Connector, South Boston Haul Road, Convention Center, I-

90/Williams Tunnel, Logan Terminal Roadway, Logan Terminal, Logan Terminal Roadway, Airport Blue Line.

The proposed BRT7 route would provide a single seat ride linking the LMA-City Hospital corridor with the South Boston Waterfront and Logan Airport. It also links these neighborhoods to every existing and planned radial transit and commuter rail line located between these points thereby providing connectivity to the entire MBTA system. There are 8 station stops planned along this 8-mile long route. Three segments of the route totaling over 2 miles would operate over exclusive or semi-exclusive rights-of-way.

- Ruggles Street busway between Huntington Avenue and Ruggles
- Melnea Cass Boulevard busway between Ruggles and Harrison Avenue
- South Boston Haul Road

As an alternate to the South Boston Haul Road the BRT7 route may instead utilize the I-93 HOV lanes between Southampton Street and I-90 where it would exit to serve the Federal Courthouse area on the way to and from the Williams Tunnel. This option presents design challenges to enter and exit the I-93 HOV lanes at the Mass Avenue Connector Road. The specific alignment is to be determined during the Phase 2 environmental process. The balance of the BRT7 route would operate in bus lanes and mixed traffic facilitated by ITS features.

3.5.2.5 BRT Fleet Size

The number of BRT buses needed to operate the Phase 2 routes was estimated using the length of the route, the peak period headways, and the assumed average speed of the route including all stops (approximately 15mph). The assumed 15mph average speed of the BRT routes represents a 20% improvement over the assumed Phase 1 speeds based on implementation of ITS features and segments of exclusive busway. For example: A route that is 7.5 miles long in each direction requires 15 miles per round trip. At an average speed of 15mph that would take 60 minutes per complete cycle, exclusive of recovery time. Using 10 minute peak period headways for the Phase 2 BRT would require 6 buses on this route to provide the planned level of service.

Thus, it is estimated that a minimum of 40 new BRT buses will be required to operate the proposed Phase 2 routes at ten-minute headways. It is assumed that another 50% will be needed for spares, which amounts to 20 additional buses. The percentage of spares is higher than used for diesel buses or 40' long CNGs because CNG buses are currently less reliable than diesel buses, and the 60' articulated CNG buses are technically more complex than 40' long buses and have not been in production as long. Ridership projections show very heavy demand for the BRT1 and BRT2 routes through Everett, Chelsea, and East Boston for which it may be necessary to provide service more frequently than every ten minutes. Providing 5-minute headways on these two routes would increase the fleet requirements by 13 vehicles plus 7 spares. The estimated fleet size, including spares, for Phase 2 BRT service is 80 BRT buses.

3.5.3 Phase 3 – Rail Transit Service

Phase 3 of the Urban Ring adds a new Urban Ring rail system between the Orange Line at Assembly Square and the former Orange Line terminus at Dudley Square. Phase 3 has two possible alignments known as Alternative A and Alternative B. Alternative A has the option of being either Green Line compatible Light Rail Transit technology (A1) or Orange Line compatible Heavy Rail Transit technology (A2). Alternative B must be Light Rail Transit technology due to the presence of grade crossings and sharper curves. Through the MIT campus the tunnel alignment for Alternatives A1 and A2 could be beneath either the Grand Junction Railroad, which was the basis of the ridership forecasting, or Vassar Street. The choice of alignment and technology for the Urban Ring rail transit system will be determined during the Phase 3 environmental process and will be implemented contingent upon timely availability of capital and operating and maintenance funds.

Alternative A1 – LRT Via Kenmore

The following description pertains to Alternative A1 depicted in Figure 3-10. It would cross the Charles River at Kenmore Square and, compared to Alternative B, follows a shorter route with fewer stations needed to connect with the MBTA radial lines. Alternative A1 uses low-floor Light Rail Transit (LRT) technology compatible with the new MBTA Green Line vehicles shown in Figure 3-13, and would interline with the Green Line Extension west of New Lechmere. The alignment and stations of Alternative A1 are 100% in tunnel except at Assembly Square and Sullivan Square. Alternative A1 in Phase 3 of the Urban Ring would include the non-redundant conventional bus, BRT, and supporting elements of Phase 2.

◦ **Changes to Phase 2 Routes**

BRT5 Dropped – The LRT routes provide this service

BRT2 Modified – This route is changed from Revere Beach Parkway to the busway adjacent to commuter rail.

Two overlapping LRT routes would be provided in Alternative A1, as described below and depicted in the Figure that follows. For planning purposes it is assumed that the Urban Ring LRT routes would utilize Green Line compatible low-floor vehicles similar to the Type 8 cars currently being acquired by the MBTA.

Between Medford Hillside and New Lechmere the LRT Route #2 assumes the Green Line Extension project shown in the Regional Transportation Plan. At a junction located just north of New Lechmere, the Urban Ring LRT Route #2 would switch from the Green Line onto the Urban Ring alignment from New Lechmere to Dudley Square.

The LRT Route #1 and Route #2 would overlap all Urban Ring LRT stations except those located north of the Green Line Extension which are served only by the LRT Route #1. Thus, there are projected to be 18 Urban Ring trains per hour (12/LRT#1 + 6/LRT#2) during the peak for all Urban Ring LRT stations, except Assembly Square and Sullivan Square which are projected to be served by 12 Urban Ring trains per hour (12/LRT#1) during the peak.

◦ **Service Frequency**

Proposed LRT Route #1 Service Frequency

- 5 minute Morning/Evening peak headway
- 15 minute Midday/Saturday headway
- 20 minute Evening/Sunday/Holiday headway

Proposed LRT Route #2 Service Frequency

- 10 minute Morning/Evening peak headway
- 15 minute Midday/Saturday headway
- 20 minute Evening/Sunday/Holiday headway

◦ **LRT Route #1 Description**

There are 10 LRT station stops proposed along the nearly 6-mile long LRT Route #1. Station spacing shown is in miles from each preceding station measured along the routes shown. The access to each station is by walk mode (W), driving and parking (D), or by kiss and ride (KR). In Alternative A1 the LRT system is all in tunnel except for a short segment near Sullivan Square and Assembly Square that is at-grade. All information in the following tables is conceptual and subject to change during the Phase 3 environmental process.

<u>Station</u>	<u>Spacing</u>	<u>Access</u>	<u>Intermodal Connections</u>
Assembly Square	0.00	W,D,KR	BRT1, T bus
Sullivan Square	0.36	W,D,KR	Orange,ComRail,BRT1,T bus
New Lechmere	0.87	W,KR	Green, BRT1/3/4/5, T bus

Kendall Square	0.97	W,KR	Red, BRT1/3/4/5 and T bus
MIT/Mass Ave.	0.49	W,KR	BRT4/5, T bus
Kenmore/Yawkey	0.98	W	GreenB/C/D, ComRail, T bus
Boylston/Park	0.43	W	BRT5, T bus
Longwood/Pasteur	0.56	W,KR	BRT5/6/7, T bus
Ruggles	0.70	W,D,KR	Orange,ComRail,BRT6/7,T bus
Dudley Square	<u>0.62</u>	W,D,KR	Silver Line, T buses
5.98 miles			

End-to-end elapsed time (run + dwell) is projected to be 20 minutes 16 seconds for LRT Route #1 in Alternative A1.

◦ **LRT Route #2 Description**

Between Medford Hillside and New Lechmere the proposed LRT Route #2 assumes the Green Line Extension stations, spacing, access, run times, dwell times and intermodal connections in the Regional Transportation Plan. At a junction located just north of New Lechmere the Urban Ring LRT Route #2 would switch from the Green Line onto the Urban Ring alignment from New Lechmere to Dudley Square. The route information shown for LRT Route #1 is applicable to LRT Route #2 from New Lechmere through Dudley Square.

Alternative A2 – Heavy Rail Via Kenmore

The following description pertains to Alternative A2 depicted in Figure 3-11. The rail element of Alternative A2 starts at Wellington (rather than Assembly Square) and its Assembly Square station could be located closer to the midway point between Wellington and Sullivan Square because Alternative A2 would operate as a branch of the Orange Line. Alternative A2 would use Orange Line compatible heavy rail vehicles similar to the existing Orange Line vehicle depicted in Figure 3-13. From Sullivan Square northward to Wellington, the existing Orange Line test track would be relocated north of Wellington. This segment becomes a three-track combined Urban Ring/Orange Line operation. South of Sullivan Square, Alternative A2 follows the same alignment and has the same station locations as Alternative A1. Alternative A1 of the Urban Ring includes the non-redundant conventional bus, BRT, and supporting elements of Phase 2.

◦ **Changes to Phase 2 Routes**

- BRT5 Dropped – The Heavy Rail route provides this service
- BRT2 Modified – This route is changed from Revere Beach Parkway to the busway adjacent to commuter rail.

A single Urban Ring Heavy Rail route would be provided in Alternative A2, as described below and depicted in the Figure that follows. For planning purposes it is assumed that the Heavy Rail routes will utilize transit vehicles compatible with those currently in use on the MBTA Orange Line.

Use of Orange Line vehicles in Alternative A2 allows the Sullivan Square, Assembly Square, and Wellington Stations to operate as joint Urban Ring/Orange Line stations served by the existing Orange Line service and the new Heavy Rail route. At these three stations, the proposed 4-minute headway of the Urban Ring Heavy Rail route combined with the existing Orange Line 5 minute headway provide a total of 27 trains/hour (15/Urban Ring Heavy Rail + 12/Existing Orange Line) in this segment, for an effective headway of just over 2 minutes in the peak. South of Sullivan Square to Dudley Square along the Urban Ring corridor service would be provided with the single Heavy Rail route that has headways of 4 minutes in the peak period for a total of 15 trains/hour.

◦ **Service Frequency**

- 4 minute Morning/Evening peak headway
- 10 minute Midday/Saturday headway
- 15 minute Evening/Sunday/Holiday headway

° **Heavy Rail Route Description**

There are 11 Heavy Rail station stops planned along this nearly 7-mile long route. Two of the stations, Wellington and Sullivan Square, already exist and would require modification rather than new construction with this alternative. Station spacing shown is in miles from the preceding station measured along the routes shown. The access is by walk mode (W), driving and parking (D), or by kiss and ride (KR). In Alternative A2 the Urban Ring Heavy Rail route is 100% in tunnel south of its connection with the existing Orange Line at Sullivan Square. From Sullivan Square northward to Wellington the existing Orange Line test track would be relocated to the north of Wellington and this segment becomes a three track combined Urban Ring/Orange Line operation.

<u>Station</u>	<u>Spacing</u>	<u>Access</u>	<u>Intermodal Connections</u>
Wellington	0.00	W,D,KR	BRT1/2/3, T bus, TelecomTMA
Assembly Square	0.60	W,D,KR	BRT1, T bus
Sullivan Square	0.60	W,D,KR	Orange,ComRail,BRT1,T bus
New Lechmere	0.87	W,KR	Green, BRT1/3/4/5, T bus
Kendall Square	0.97	W,KR	Red, BRT1/3/4/5 and T bus
MIT/Mass Ave.	0.49	W,KR	BRT4/5, T bus
Kenmore/Yawkey	0.98	W	GreenB/C/D, ComRail, T bus
Boylston/Park	0.43	W	BRT5, T bus
Longwood/Pasteur	0.56	W,KR	BRT5/6/7, T bus
Ruggles	0.70	W,D,KR	Orange,ComRail,BRT6/7,T bus
Dudley Square	<u>0.62</u>	W,D,KR	Silver Line, T buses
	6.82 miles		

End-to-end elapsed time (run + dwell) is projected to be 20 minutes 55 seconds for the Heavy Rail route in Alternative A2. Because it starts at Wellington rather than Sullivan Square a direct comparison of end-to-end times with Alternative A1 is only possible between Sullivan Square and Dudley Square. Between those same end points, alignment, and station locations Alternative A2 elapsed time is projected to be approximately 2 minutes faster than Alternative A1, primarily due to higher performance characteristics of Heavy Rail. Dwell times were assumed to be the same at each station for Alternatives A1 and A2. It is, however, possible that the Heavy Rail would load and unload faster than LRT during peak loads due to the high level platform and flat floor throughout the Heavy Rail vehicle and more convenient configuration of the door openings.

Alternative B – LRT Via BU/Park Drive

The following description pertains to Alternative B depicted in Figure 3-12. It would cross the Charles River at Cambridgeport/BU and, compared to Alternatives A1 and A2, follows a longer route with more stations needed to connect with the MBTA radial lines. As with Alternative A1, Alternative B uses low-floor Light Rail Transit (LRT) technology compatible with the new MBTA Green Line vehicles shown in Figure 3-13, and would interline with the Green Line Extension west of New Lechmere. The alignment and stations of Alternative B are mostly at-grade north of the Charles River and 100% in tunnel beneath the Charles River to Dudley Square. Alternative B of the Urban Ring includes the non-redundant conventional bus, BRT, and supporting elements of Phase 2.

° **Changes to Phase 2 Routes**

BRT5 Dropped – The LRT routes provide this service

BRT2 Modified – This route is changed from Revere Beach Parkway to the busway adjacent to commuter rail.

Two overlapping LRT routes would be provided in Alternative B, as described below and depicted in the Figure that follows. For planning purposes it is assumed that the Urban Ring LRT routes will utilize Green Line compatible low-floor vehicles similar to the Type 8 cars currently being acquired by the MBTA.

Between Medford Hillside and New Lechmere the LRT Route #2 assumes the Green Line Extension in the Regional Transportation Plan. At a junction located just north of New Lechmere, the Urban Ring LRT Route #2 would switch from the Green Line onto the Urban Ring alignment from New Lechmere to Dudley Square.

The LRT Route #1 and Route #2 are proposed to overlap all Urban Ring LRT stations, except those located north of the Green Line Extension which are served only by the LRT Route #1. Thus, there are projected to be 18 Urban Ring trains per hour (12/LRT#1 + 6/LRT#2) during the peak for all Urban Ring LRT stations, except Assembly Square and Sullivan Square that are projected to be served by 12 Urban Ring trains per hour (12/LRT#1) during the peak.

◦ **Service Frequency**

Proposed LRT Route #1 Service Frequency

- 5 minute Morning/Evening peak headway
- 15 minute Midday/Saturday headway
- 20 minute Evening/Sunday/Holiday headway

Proposed LRT Route #2 Service Frequency

- 10 minute Morning/Evening peak headway
- 15 minute Midday/Saturday headway
- 20 minute Evening/Sunday/Holiday headway

◦ **LRT Route #1 Description**

There are 14 LRT station stops planned along this nearly 7-mile long route. Station spacing shown is in miles from the proceeding station measured along the routes shown. The access is by walk mode (W), driving and parking (D), or by kiss and ride (KR). In Alternative B the LRT system operates mostly on the surface in Somerville and East Cambridge except for a cut and cover tunnel section between New Lechmere and Broadway.

<u>Station</u>	<u>Spacing</u>	<u>Access</u>	<u>Intermodal Connections</u>
Assembly Square	0.00	W,D,KR	BRT1, T bus
Sullivan Square	0.36	W,D,KR	Orange,ComRail,BRT1,T bus
New Washington St.	0.45	W,KR	T bus
Fitchburg Street	0.44	W,KR	Green
New Lechmere	0.44	W,KR	Green, BRT1/3/4, T bus
Linskey Way	0.70	W	BRT1/3/4, T bus
Kendall Square	0.46	W,KR	Red, BRT1/3/4, T bus
MIT/Mass Ave.	0.39	W,KR	BRT4, T bus
Cambridgeport	0.58	W,KR	BRT4, T bus
BU Central/CRR	0.64	W,KR	Green B, ComRail, T bus
Green Line C/D	0.27	W,KR	Green C/D, T bus
Longwood/Pasteur	0.71	W,KR	BRT6/7, T bus
Ruggles	0.70	W,D,KR	Orange,ComRail,BRT6/7,T bus
Dudley Square	<u>0.62</u>	W,D,KR	Silver Line, T buses
	6.76 miles		

End-to-end elapsed time (run + dwell) is projected to be 25 minutes 16 seconds for LRT Route #1 in Alternative B.

◦ **LRT Route #2 Description**

Between Medford Hillside and New Lechmere the LRT Route #2 assumes the Green Line Extension stations, spacing, access, run times, dwell times and intermodal connections in the Regional Transportation Plan. At a junction located just north of New Lechmere the Urban Ring LRT Route #2

would switch from the Green Line onto the Urban Ring alignment from New Lechmere to Dudley Square. The route information shown for LRT Route #1 is applicable to LRT Route #2 from New Lechmere through Dudley Square.

Details regarding the fleet size, routes, stations, costs and schedule of the Phase 3 alternatives will be determined during the DEIR/S process.

3.6 Alternatives and Phasing By Geographic Area

To more clearly depict the routing, station locations and phasing of the alternatives at the municipal and neighborhood level, and to see the relationship between existing services and the proposed Urban Ring services, a series of color maps were developed for each of the following geographic areas which, taken together, comprise the entire Urban Ring Corridor.

- East Boston, Chelsea and Everett (Figures 3-14 through 3-17)
- Somerville (Figures 3-18 through 3-23)
- Cambridge (Figures 3-24 through 3-29)
- Brookline and Boston (Figures 3-30 through 3-35)
- Roxbury and Dorchester (Figures 3-36 through 3-40)
- South Boston (Figures 3-41 through 3-43)

For each of the above listed geographic areas the maps depict the following information in sequence.

- Existing MBTA Service
- Urban Ring Phase 1
- Urban Ring Phase 2
- Urban Ring Phase 3 Alternative A1
- Urban Ring Phase 3 Alternative A2
- Urban Ring Phase 3 Alternative B

Figures containing these maps are provided at the end of this Chapter.

Table 3-1
Phase I Urban Ring Bus Routes

Type	Name	End Points		Number of Stops	Length
Express ¹	EC1	Woburn Intermodal	Kendall/MIT	4	14 mi.
	EC2	Riverside	Lechmere	6	14 mi.
	EC3	Route 9 Natick	Kenmore	6	24 mi.
Crosstown ^{2, 3}	CT1	Central Square	Andrew	10	4 mi.
	CT2	Sullivan Square	Longwood/LMA	11	6 mi.
	CT3	Longwood/LMA	Logan Airport ⁴	8	8 mi.
	CT4	Ruggles	UMass Campus ⁴	5	5 mi.
	CT5	Logan Airport	Sullivan Square	12	8 mi.
	CT6	Chelsea Downtown	Kendall/MIT	3	5 mi.
	CT7	Kendall/MIT	Franklin Park	11	7 mi.
	CT8	Sullivan Square	Longwood/LMA	7	5 mi.
	CT9	Kenmore	Harvard Square	5	5 mi.
	CT10	Kenmore	JFK/UMass	8	5 mi.
	CT11	Longwood/LMA	Fields Corner	9	6 mi.

¹ EC routes to operate similar to existing MBTA Express Bus service with 12-minute headways including reverse direction service.

² CT routes to operate similar to existing MBTA Crosstown (CT) limited-stop service connecting rapid transit nodes and major activity centers with 10-minute peak period headways and 20-minute off-peak headways.

³ CT1, CT2, CT3 are modifications to existing routes. All other routes shown are new

⁴ In Phase 1 the proposed CT3, CT4 and CT5 routes would serve locations currently served by non-MBTA shuttle bus operators. Implementation of Phase 1 service in such locations will need to address issues of vehicle purchase, operating subsidy, 13(c) indemnification, and indemnification of competition claims from current shuttle contractors. Location of existing private shuttle operation.

**Table 3-2
Phase 2 Urban Ring Bus Rapid Transit (BRT) Routes**

Type	Name	End Points		Number of Stations	Length
Bus Rapid Transit	BRT1	Logan Airport ¹	Kendall/MIT	14	10 mi.
	BRT2	Logan Airport ¹	Wellington	5	6 mi.
	BRT3	Wellington	Kendall/MIT	6	5 mi.
	BRT4	Riverside	Kendall/MIT	7	11 mi.
	BRT5	New Lechmere	Longwood/LMA	10	4 mi.
	BRT6	Longwood/LMA	UMass Campus ¹	11	6 mi.
	BRT7	Longwood Medical Area	Logan Airport ¹	8	8 mi.

**Table 3-3
Phase 3 Urban Ring Rail Routes - By Alternative**

Alternative	Name	End Points		Number of Stations	Length
A1 Light Rail Via Kenmore	LRT1	Assembly Square	Dudley Square	10	6.0 mi.
	LRT2	Medford Hillside	Dudley Square	13	9.3 mi.
A2 Heavy Rail Via Kenmore	HRT	Wellington	Dudley Square	11	6.8 mi.
B Light Rail Via BU/Park Dr.	LRT1	Assembly Square	Dudley Square	14	6.8 mi.
	LRT2	Medford Hillside	Dudley Square	17	9.6 mi.

¹ In Phase 2 the proposed BRT1, BRT2 and BRT6 routes would serve locations currently served by non-MBTA shuttle bus operators. Implementation of Phase 2 service in such locations will need to address issues of vehicle purchase, operating subsidy, 13(c) indemnification, and indemnification of competition claims from current shuttle contractors to the extent that they have not already been resolved in Phase 1.

Table 3-4
Features By Phase

Feature	Phase 1 Transportation System Management Improved Bus Service	Phase 2 Bus Rapid Transit (BRT)	Phase 3 Rail Service A1, A2, B
Time Frame	Years 0-5 from MIS	Years 6-10 from MIS	Years 11-15 from MIS
Technology	40 Foot Low-Emission Buses Modified Existing Crosstown Routes New Crosstown Routes New Express Bus Service	60 Foot Articulated CNG Low-Floor Technology with signal priority, ITS, Commuter Rail interfaces, passenger amenities, and segments of separate r-o-w New and improved commuter rail stations	New Rail Service (Light Rail or Heavy Rail) Supplements Existing Rail Service
Construction	None (uses existing infrastructure)	New and modified roadways, busways, intersection improvements and modified or new commuter rail stations	New rail track, structures, tunnel Under Charles River, stations, and new or expanded maintenance facility
Vehicles	100 low floor 40' CNG buses (75 service + 25 spares)	[Approximately half of Phase 1 bus routes continue to operate using buses purchased in Phase 1] 80 low floor 60' CNG BRT buses (53 service + 27 spares)	[Approximately half of Phase 1 bus routes continue to operate using buses purchased in Phase 1] [Six of the seven Phase 2 BRT routes continue to operate using BRT vehicles purchased in Phase 2] 80 LRT or Heavy Rail vehicles (70 service + 10 spares)

Table 3-5
Service Frequency By Phase

Period	Headway in Minutes				
	Phase 1	Phase 2	Phase 3 - Rail		
	Bus	BRT	Alternative A1	Alternative A2	Alternative B
Peak Morning/Peak Evening	10	10	3.3 *	4	3.3 *
Midday/Saturdays	20	15	7.5 **	10	7.5 **
Sundays/Holidays/Evening	20	20	10 ***	15	10 ***

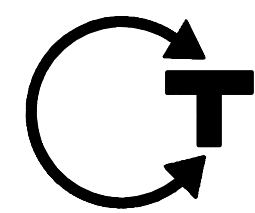
* Effective headway of two overlapping light rail routes, one with 5 minute headway, one with 10 minute.
 ** Effective headway of two overlapping light rail routes, each with 15 minute headways.
 *** Effective headway of two overlapping light rail routes, each with 20 minute headways.

Table 3-6
List of Stations by Phase and Service

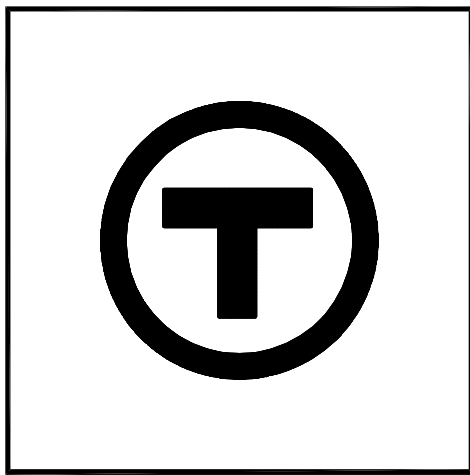
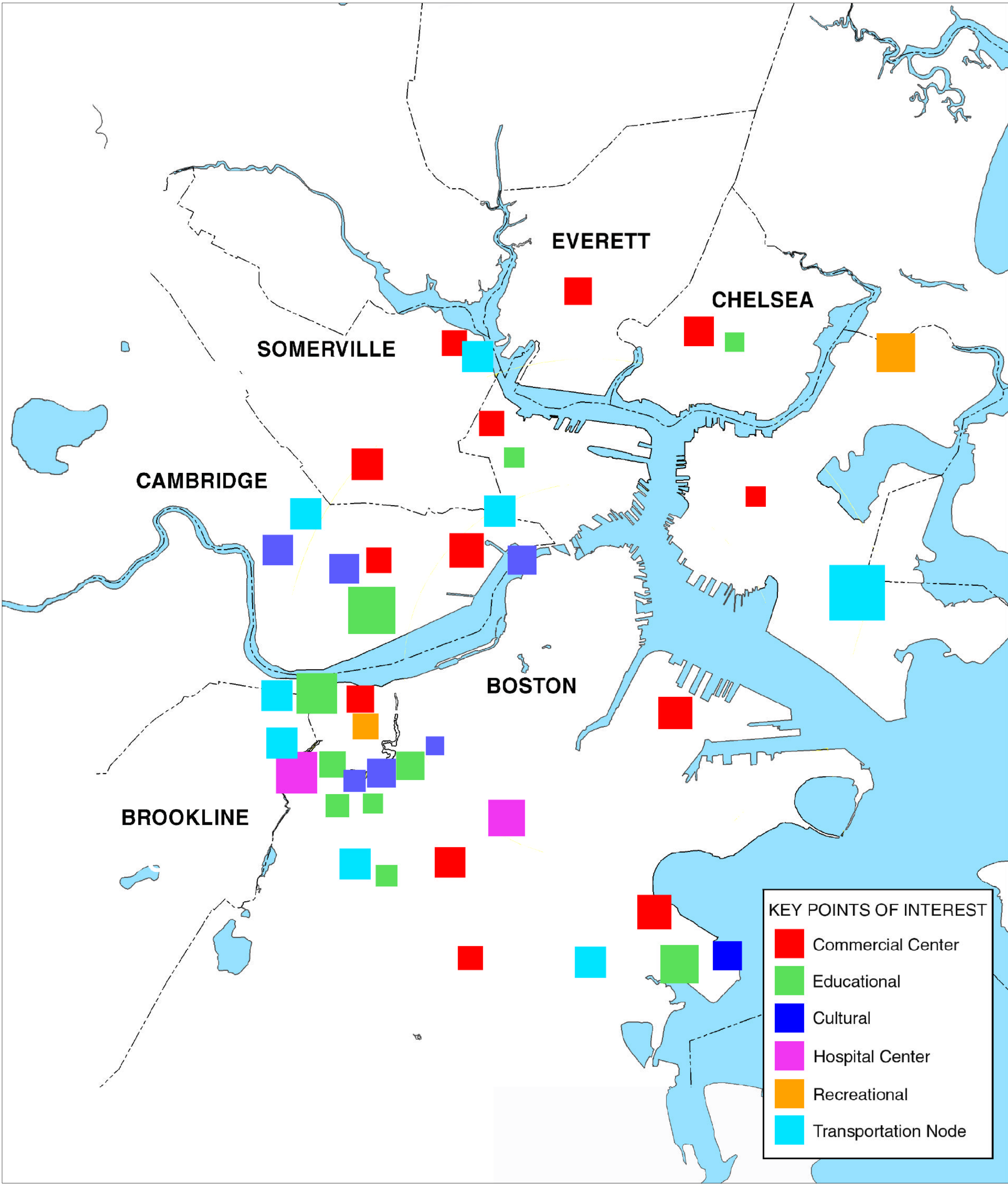
STATION	LOCATION	CONNECTIONS		Urban Ring Service			
		Commuter	Transit	Type	PHASE 2	PHASE 3	PHASE 3
		Rail				A	B
Logan Terminals ¹	Boston			BRT	•	•	•
Airport Blue Line	Boston		BLUE	BRT	•	•	•
Chelsea Commuter Rail ²	Chelsea	New/Rockport		BRT	•	•	•
Everett Avenue / Mystic Mall	Chelsea			BRT	•	•	•
Revere Beach Parkway	Everett			BRT	•	•	•
Second Street	Everett			BRT	•	•	•
Broadway	Everett			BRT	•	•	•
Wellington	Medford		ORANGE	BRT	•	•	•
Wellington	Medford		ORANGE	RAIL		A2	
Assembly Square	Somerville			BRT	•	•	•
Assembly Square	Somerville			RAIL		•	•
Gilman Square	Somerville	Lowell	GREEN	BRT	•	•	•
Union Square	Somerville	Fitchburg		BRT	•	•	•
Sullivan Square	Boston	New/Rockport, Haverhill	ORANGE	BRT	•	•	•
Sullivan Square	Boston	New/Rockport, Haverhill	ORANGE	BRT		•	•
New Washington St.	Somerville			BRT	•	•	•
New Washington St.	Somerville			RAIL			•
Community College	Boston		ORANGE	BRT	•	•	•
Fitchburg St.	Somerville			RAIL			•
New Lechmere	Cambridge		GREEN	RAIL		•	•
New Lechmere	Cambridge		GREEN	BRT	•	•	•
First Street / Galleria	Cambridge			BRT	•	•	•
Kendall Square	Cambridge		RED	RAIL		•	•
Kendall Square	Cambridge		RED	BRT	•	•	•
MIT / Mass Avenue	Cambridge			RAIL		•	•
MIT / Mass Avenue	Cambridge			BRT	•	•	•
Cambridgeport	Cambridge			RAIL			•
Cambridgeport	Cambridge			BRT	•	•	•
BU / St. Mary's	Boston	Framingham/Worcester		RAIL			•
BU / St. Mary's	Boston		GREEN	BRT	•	•	•
Kenmore / Yawkey	Boston	Framingham/Worcester	GREEN	RAIL		•	
Kenmore / Yawkey	Boston	Framingham/Worcester	GREEN	BRT	•	•	•
Fenway	Boston		GREEN	RAIL		•	•
Fenway	Boston		GREEN	BRT	•	•	•
Longwood / Pasteur	Boston			RAIL		•	•
Longwood / Pasteur	Boston			BRT	•	•	•
Huntington Avenue	Boston		GREEN	BRT	•	•	•
Ruggles	Boston	Franklin /Stoughton	ORANGE	RAIL		•	•
Ruggles	Boston	Franklin /Stoughton	ORANGE	BRT	•	•	•
Dudley Square	Boston		SILVER	RAIL		•	•
Washington St. / Silver Line	Boston		SILVER	BRT	•	•	•
Boston Medical Center	Boston			BRT	•	•	•
Blue Hill Avenue	Boston			BRT	•	•	•
Uphams Corner	Boston	Readville		BRT	•	•	•
Edward Everett Square	Boston			BRT	•	•	•
JFK / UMass	Boston	Old Colony	RED	BRT	•	•	•
UMass Campus ¹	Boston			BRT	•	•	•
Crosstown / Albany	Boston			BRT	•	•	•
Biosquare	Boston			BRT	•	•	•
Convention Center	Boston			BRT	•	•	•

¹ Location of existing private shuttle operation. Refer to paragraphs S.6.5.1 and S.6.5.2 for discussion of issues.

² A BRT station near the corner of Eastern Avenue in Chelsea is recommended, though not shown in this table.



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Urban Ring Corridor

Key Points of Interest

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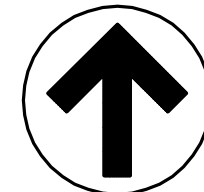
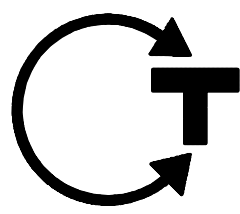
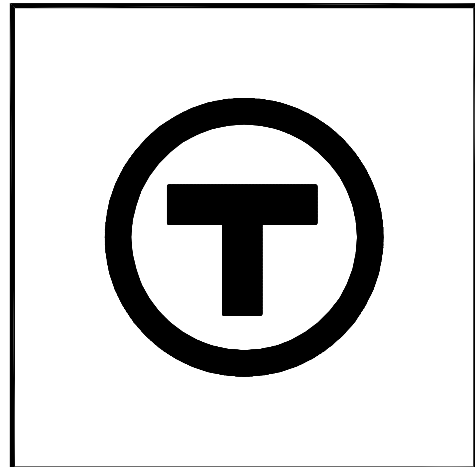
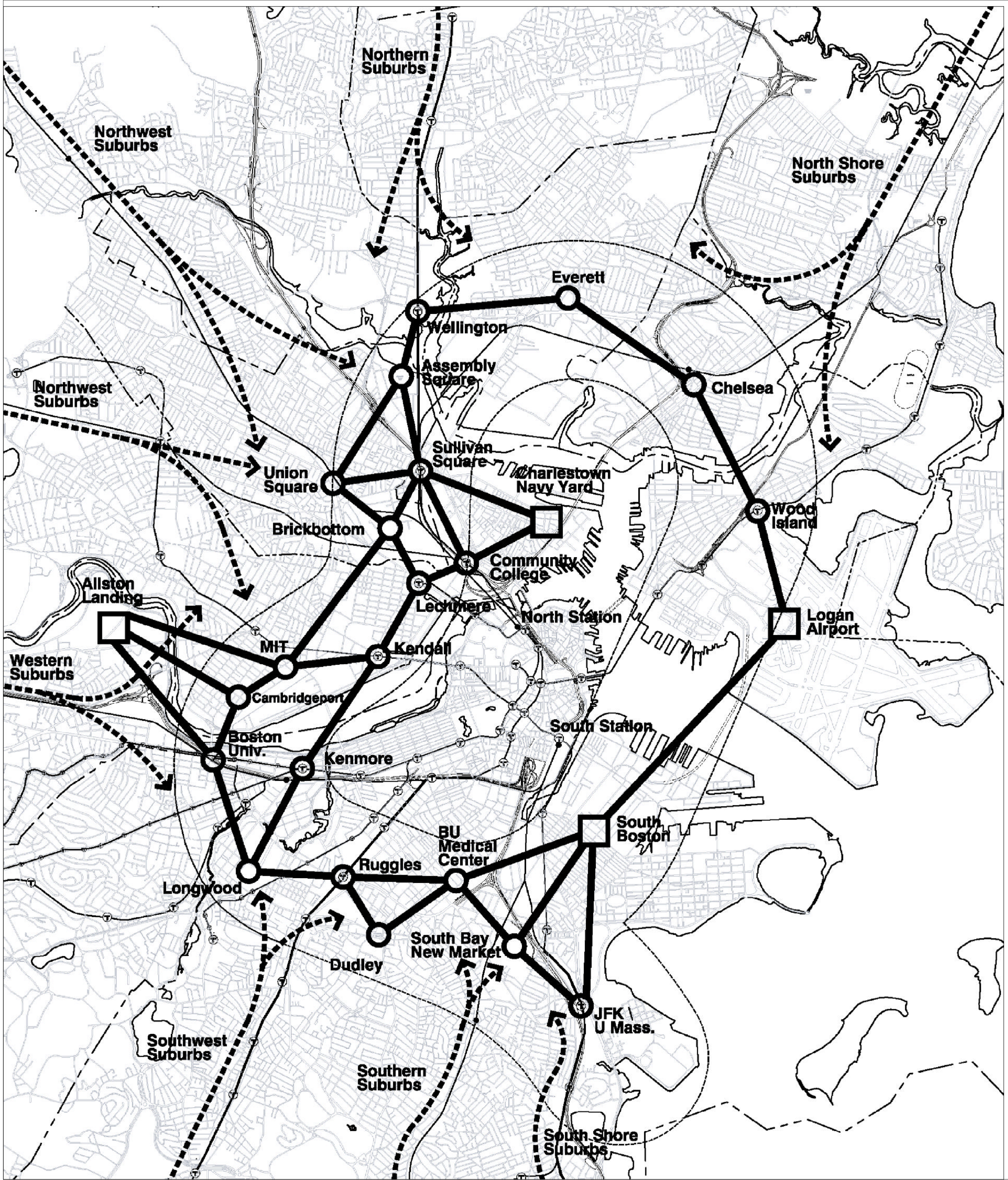


Figure 3-1

Not to Scale



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Linkages

JULY 1997

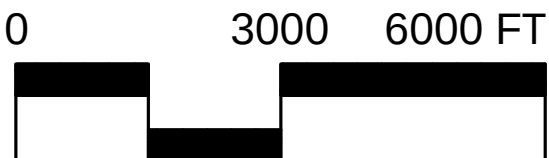
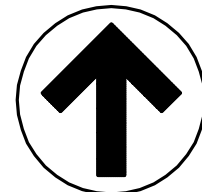
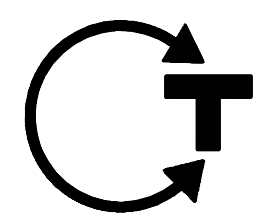
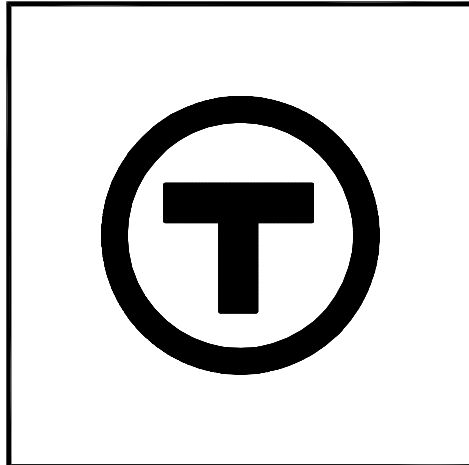
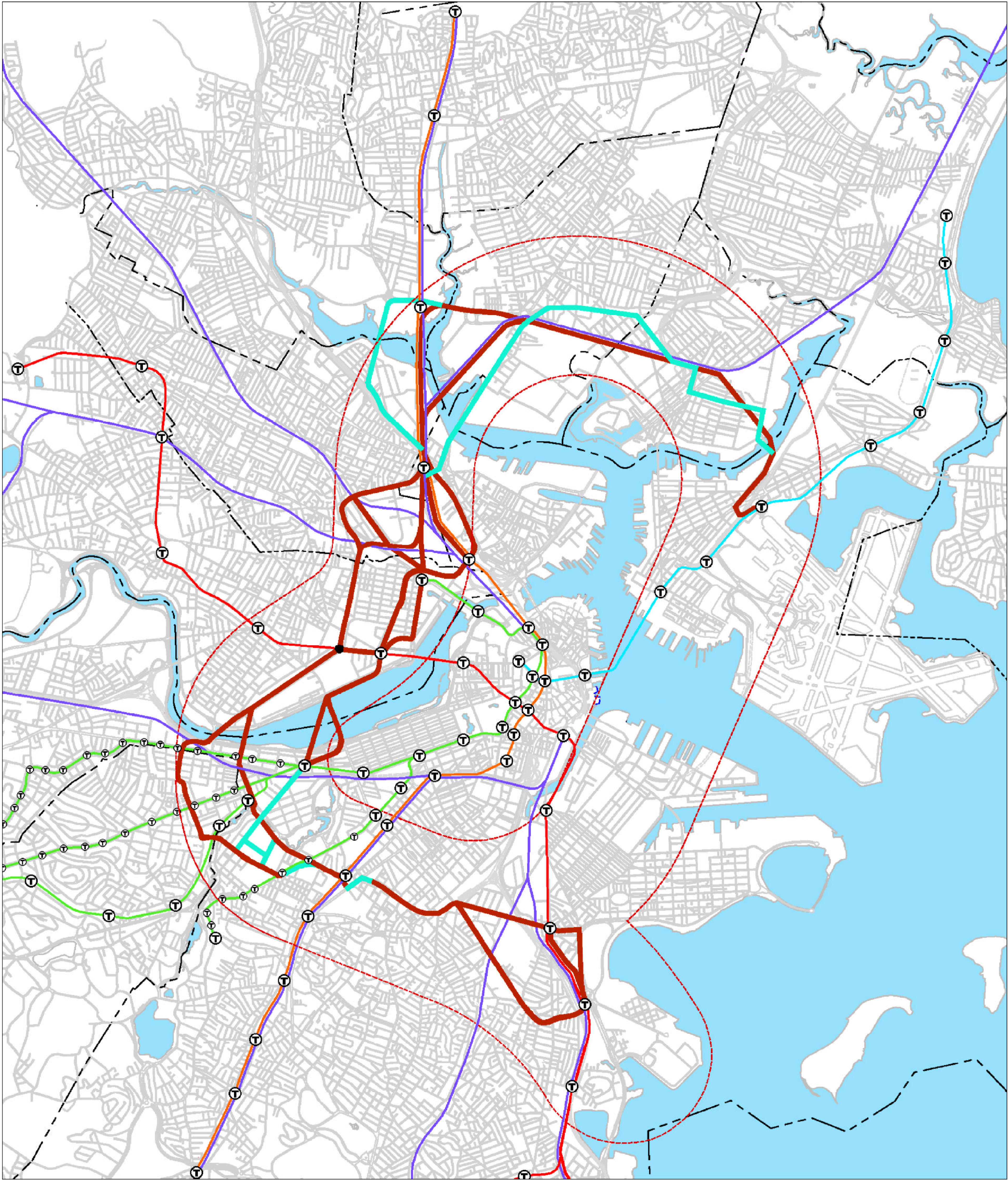


Figure 3-2



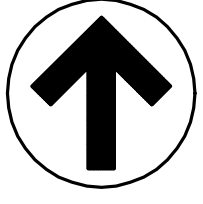
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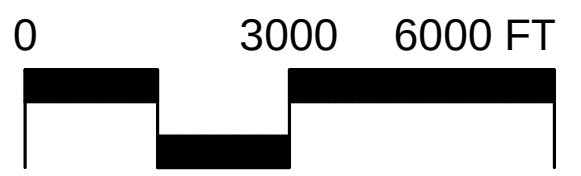
Preliminary Alignment Options

Figure 3-3

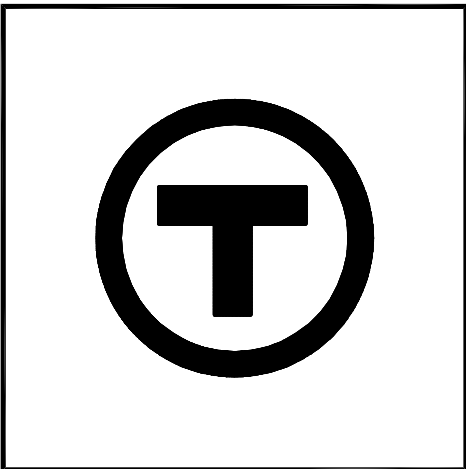
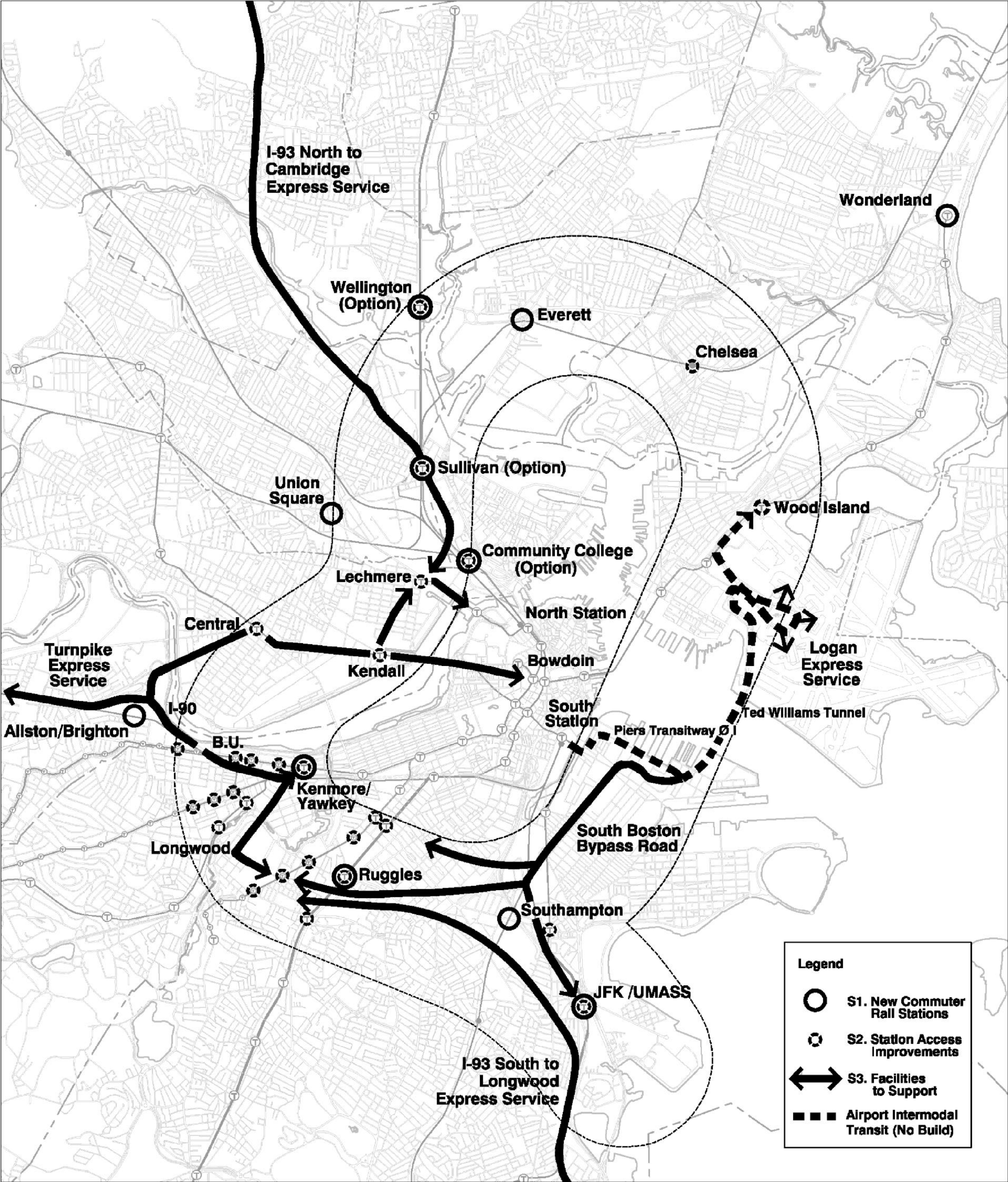
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Supporting Elements

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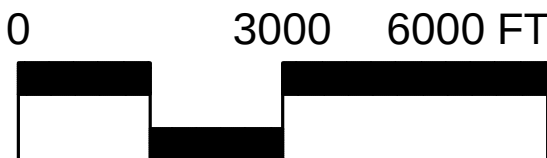
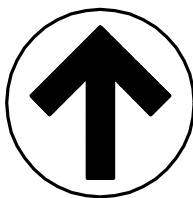
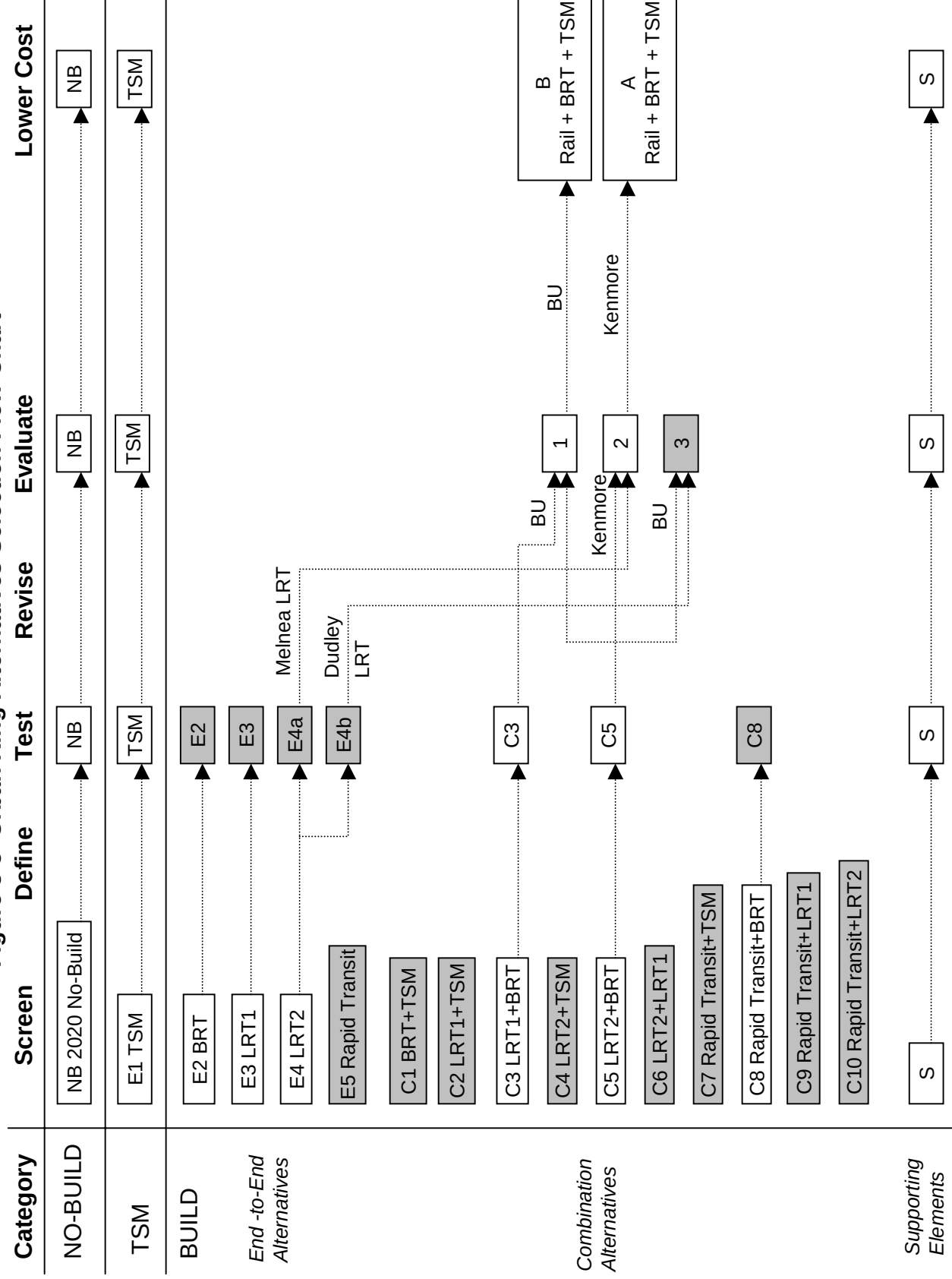
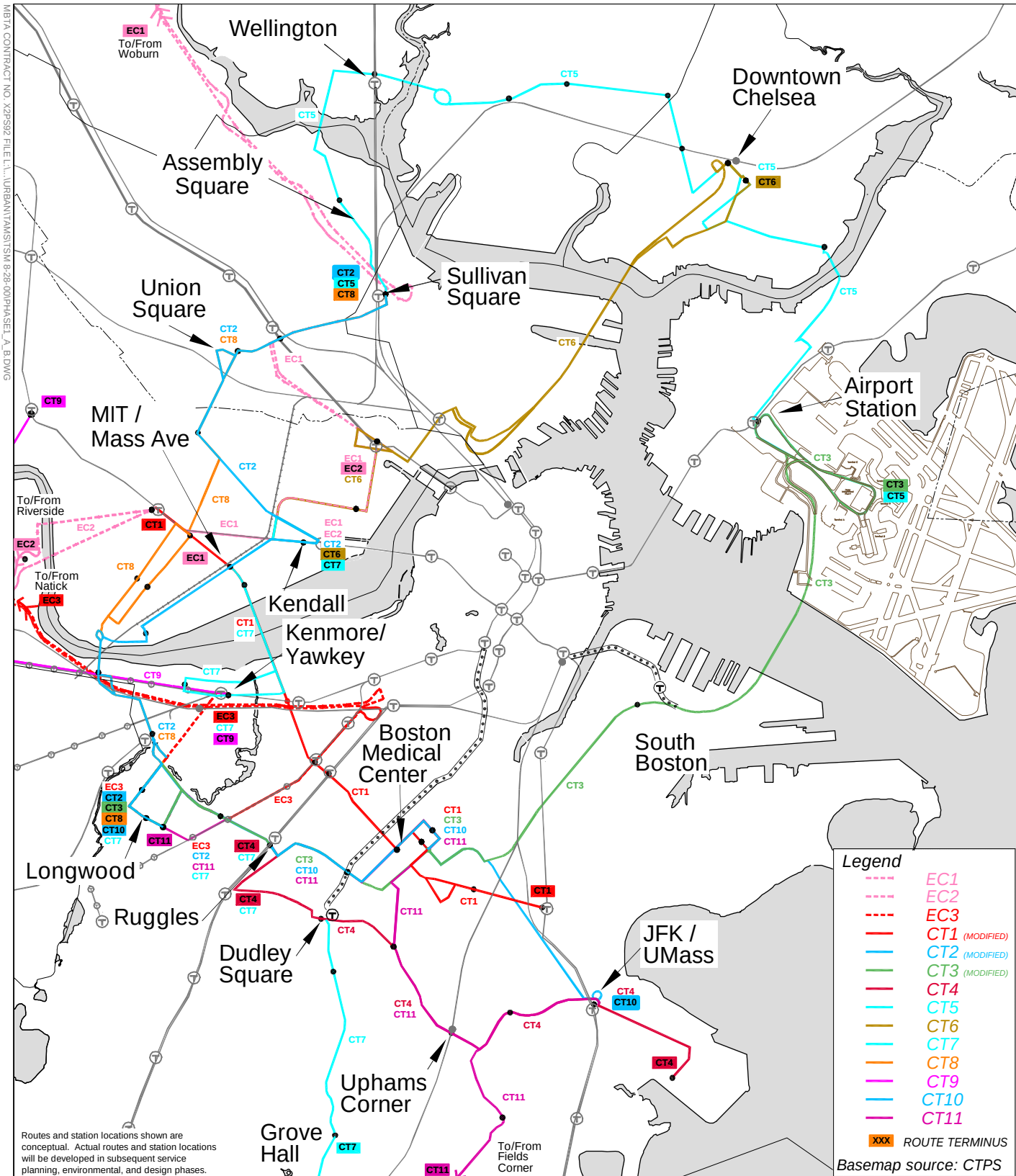


Figure 3-4

Figure 3-5 Urban Ring Alternatives Selection Flow Chart





Urban Ring Corridor

Phase 1 - Improved Bus Service

Figure 3-6

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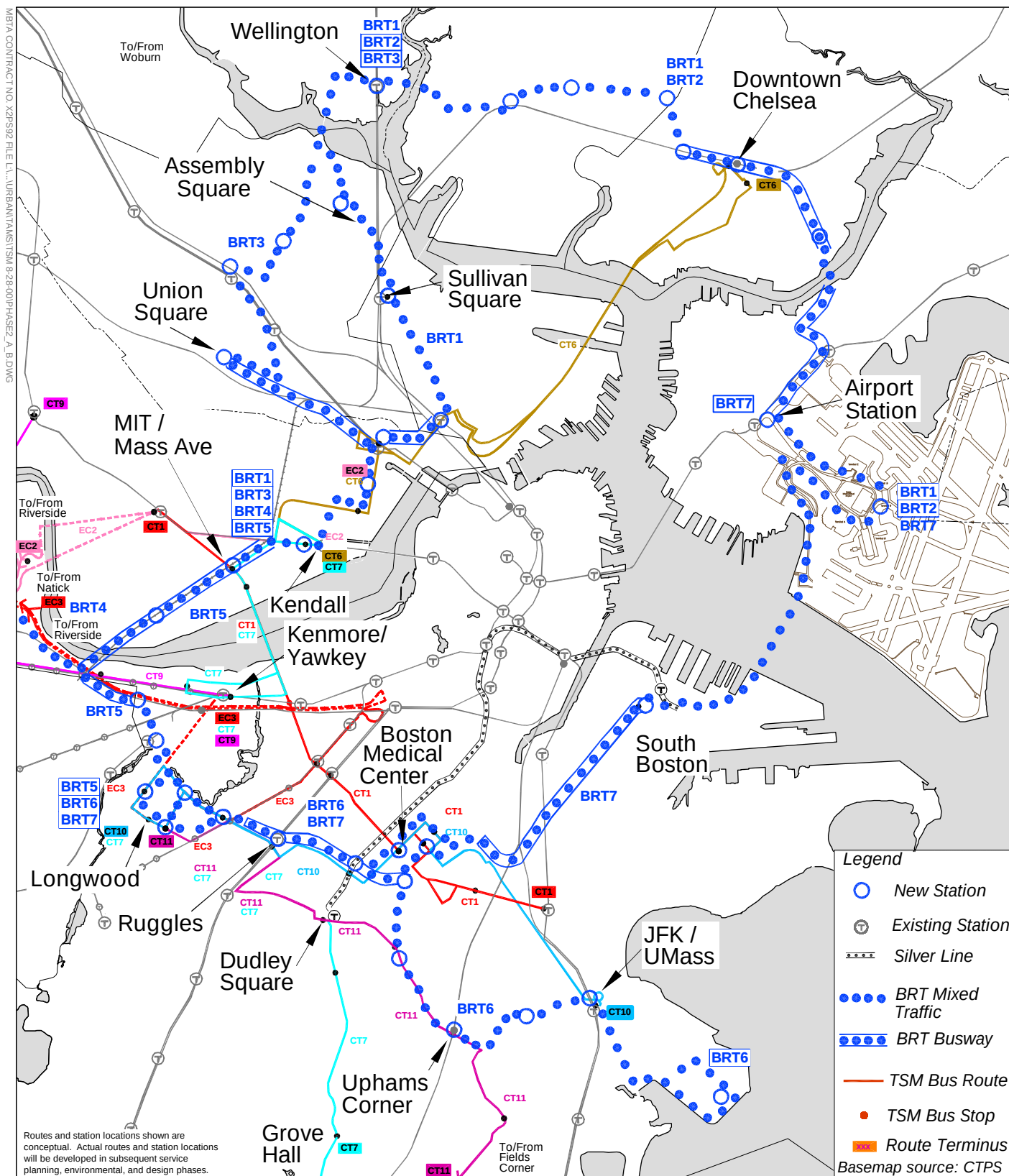
FIGURE 3-7
Phase 1 – CT/EC Vehicle Examples



Existing MBTA 40' Diesel CT Bus



Future 40' Low-Floor CNG CT/EC Bus



Urban Ring Corridor

Phase 2 - Bus Rapid Transit (BRT)

Figure 3-8

JULY 2001



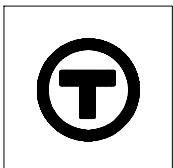
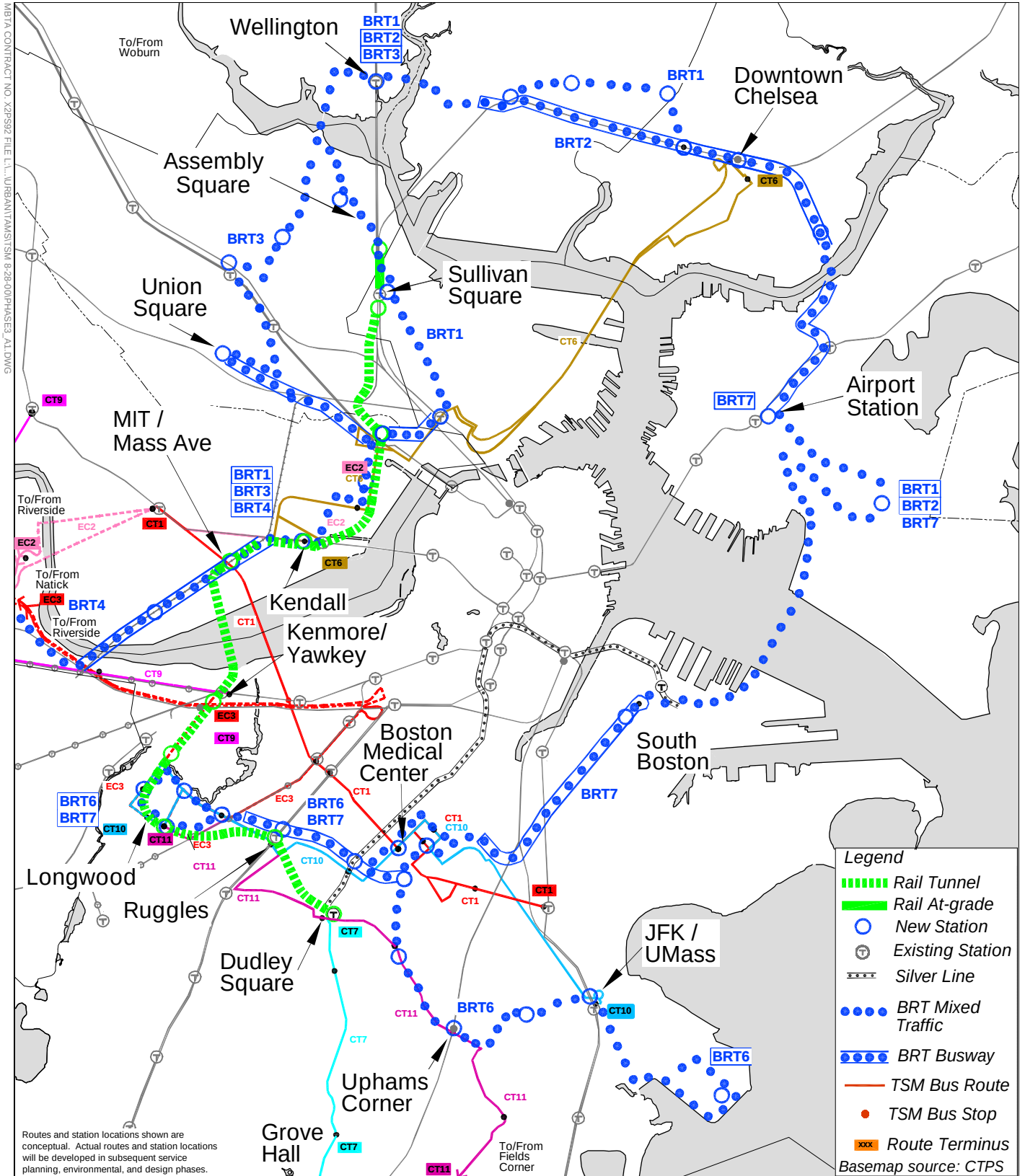
FIGURE 3-9
Phase 2– BRT Vehicle Examples



Future 60' Articulated, Low-Floor, CNG BRT Vehicle



European Example of BRT Vehicle and Station



Urban Ring Corridor

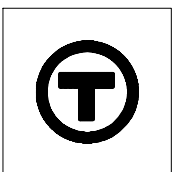
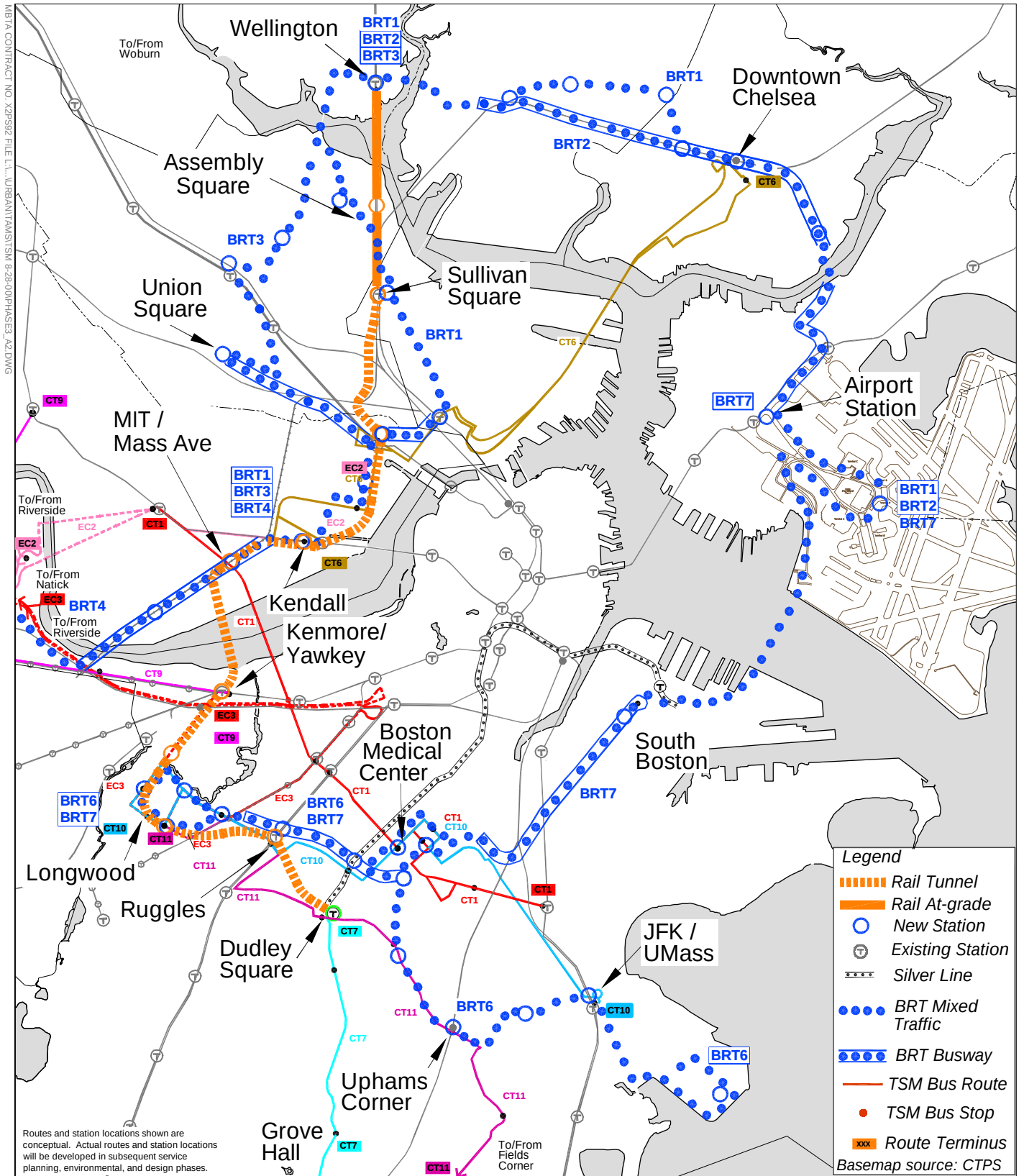
Phase 3 - Rail Alternative A1 - Kenmore

(LRT)

Figure 3-10

JULY 2001





Urban Ring Corridor

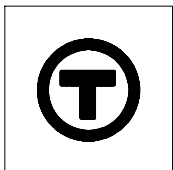
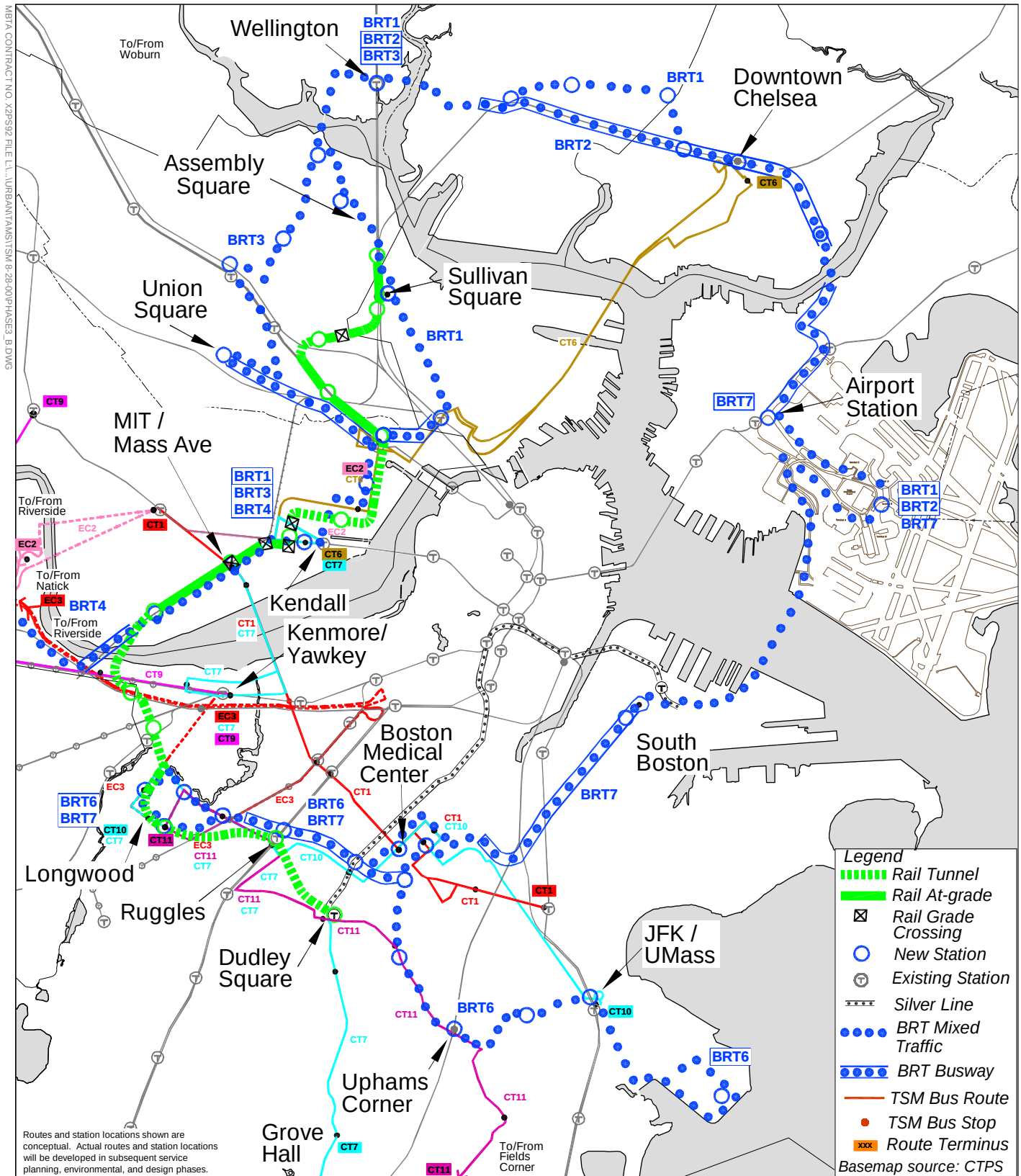
Phase 3 - Rail Alternative A2 - Kenmore

(Heavy Rail)

Figure 3-11

JULY 2001





Urban Ring Corridor

Phase 3 - Rail Alternative B - BU/Park Drive

(LRT)

Figure 3-12

JULY 2001



FIGURE 3-13
Phase 3 – Rail Transit Vehicle Examples



MBTA Light Rail Transit (LRT) Type 8 Vehicle on Green Line
Applicable to Urban Ring Alternatives A1 and B



MBTA Heavy Rail Transit Vehicle on Orange Line
Applicable to Urban Ring Alternative A2

FIGURE 3-14
East Boston, Chelsea & Everett
Existing MBTA Services

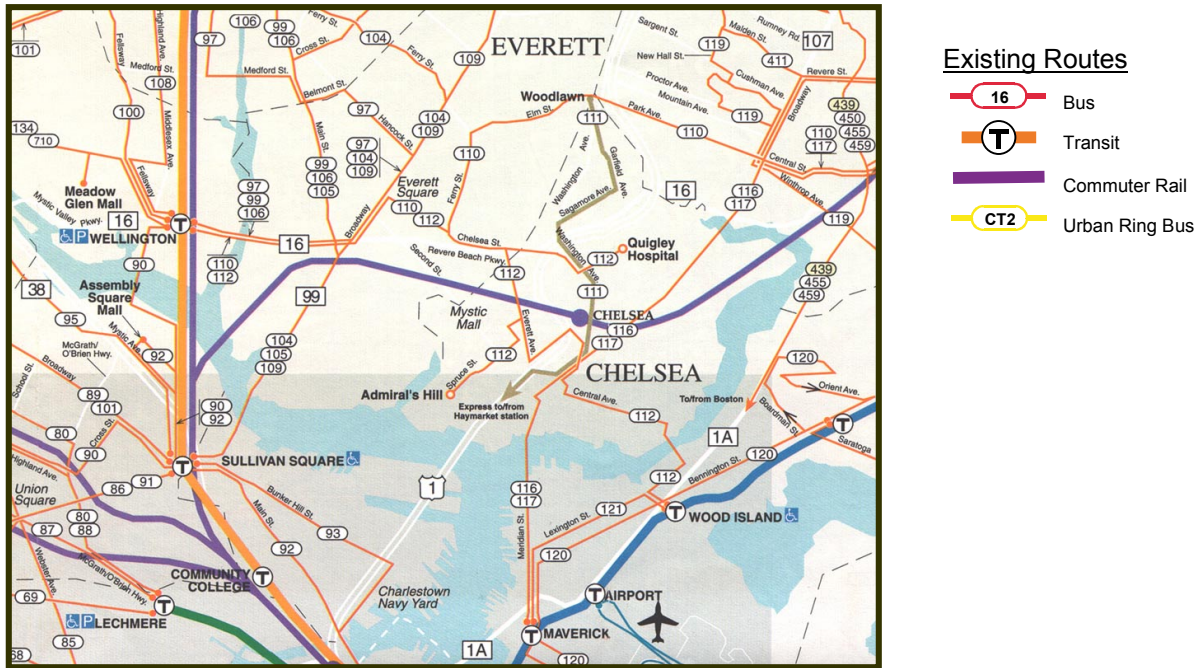


FIGURE 3-15
East Boston, Chelsea & Everett
Urban Ring Phase 1

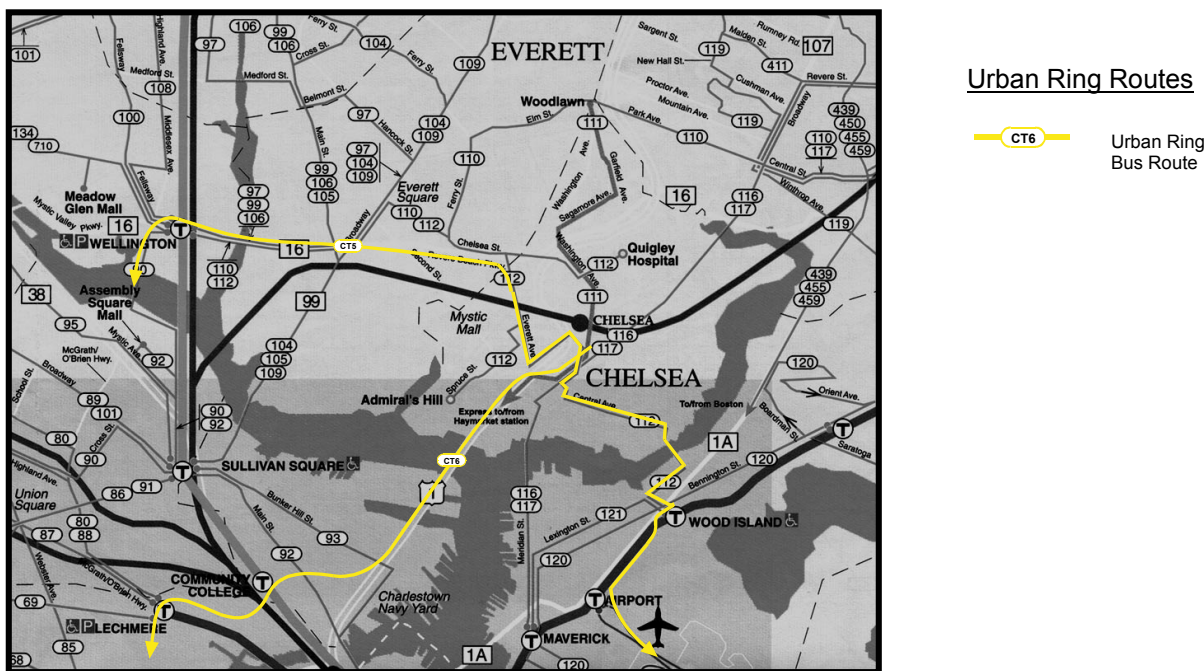
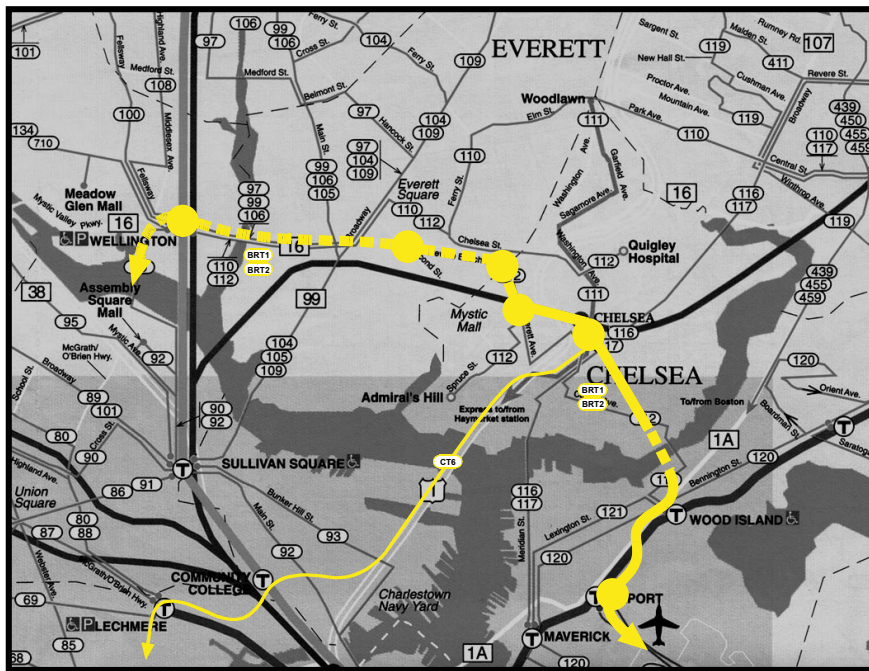


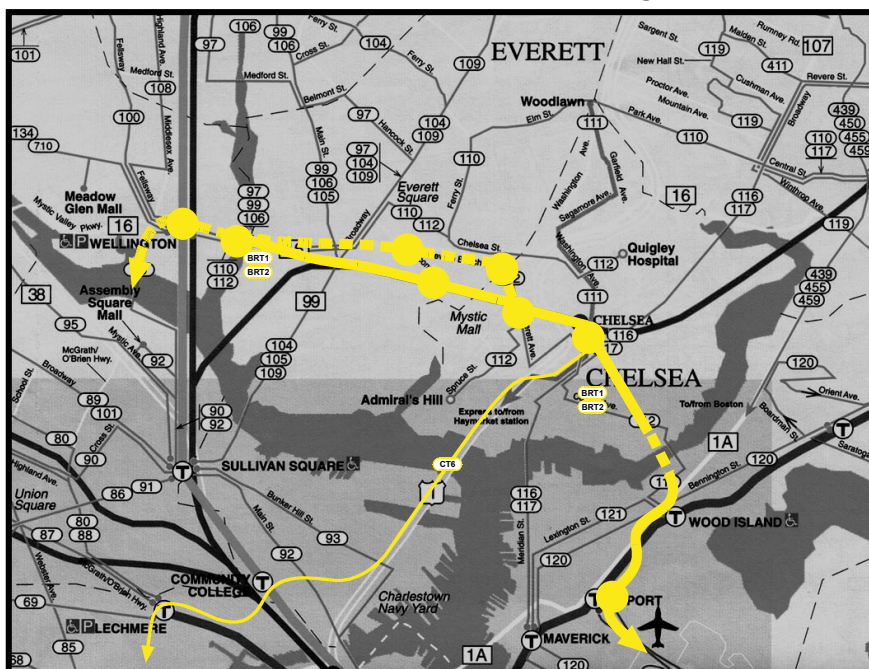
FIGURE 3-16
East Boston, Chelsea & Everett
Urban Ring Phase 2



Urban Ring Routes

- BRT Mixed Traffic
- BRT Busway
- CT6 Urban Ring Bus Route
- BRT1 BRT Route Number

FIGURE 3-17
East Boston, Chelsea & Everett
Urban Ring Phase 3



Urban Ring Routes

- BRT Mixed Traffic
- BRT Busway
- CT6 Urban Ring Bus Route
- BRT1 BRT Route Number

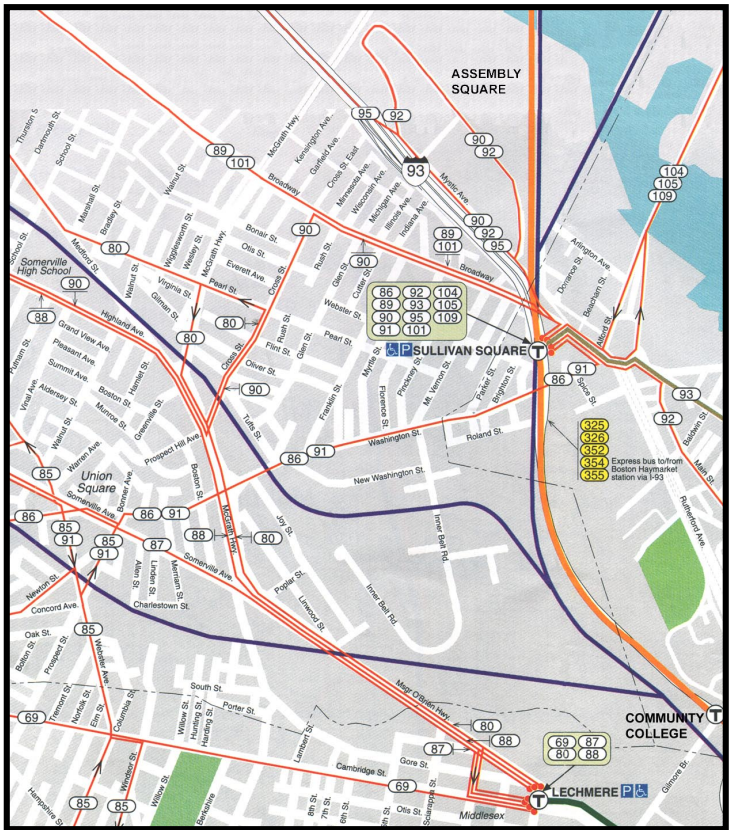


FIGURE 3-18
Somerville
Existing MBTA Services

Existing Routes

-  16 Bus
-  Transit
-  Commuter Rail
-  CT2 Urban Ring Bus

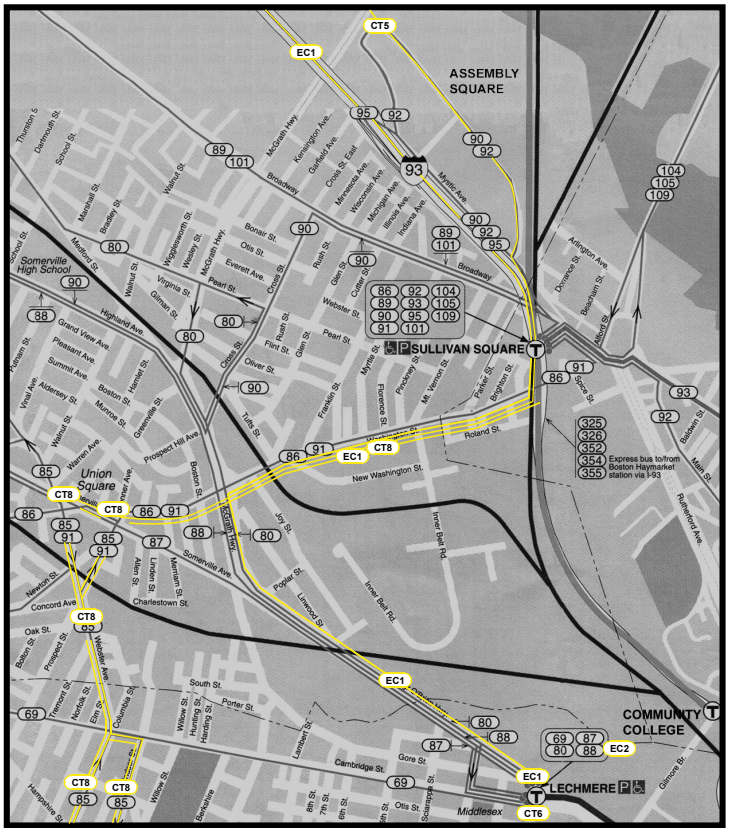


FIGURE 3-19
Somerville
Urban Ring Phase 1

Urban Ring Routes

-  CT6 Urban Ring Bus Route

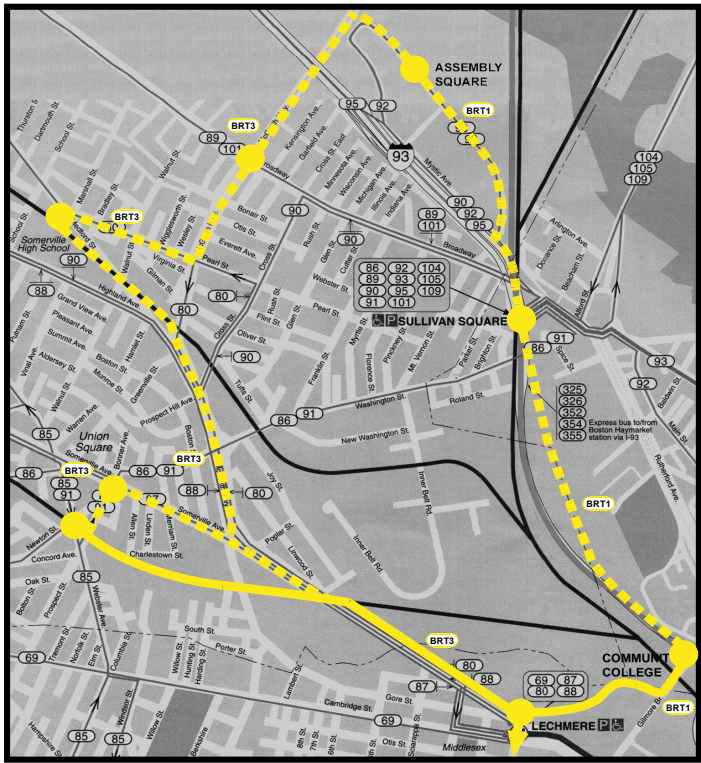


FIGURE 3-20
Somerville
Urban Ring Phase 2

Urban Ring Routes

-  BRT Mixed Traffic
-  BRT Busway
-  BRT Route Number

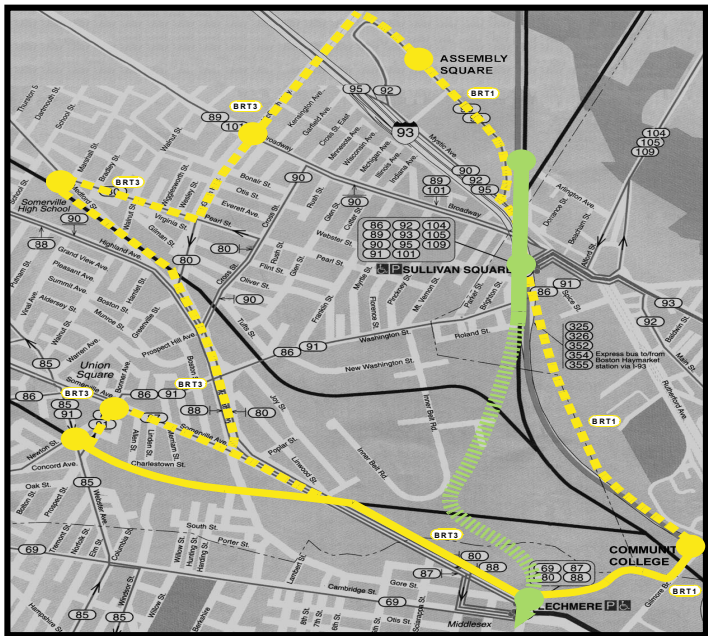


FIGURE 3-21
Somerville
Urban Ring Phase 3 – Alternative A1

Urban Ring Routes

-  LRT Surface
-  LRT Tunnel
-  BRT Route Number
-  BRT Mixed Traffic
-  BRT Busway

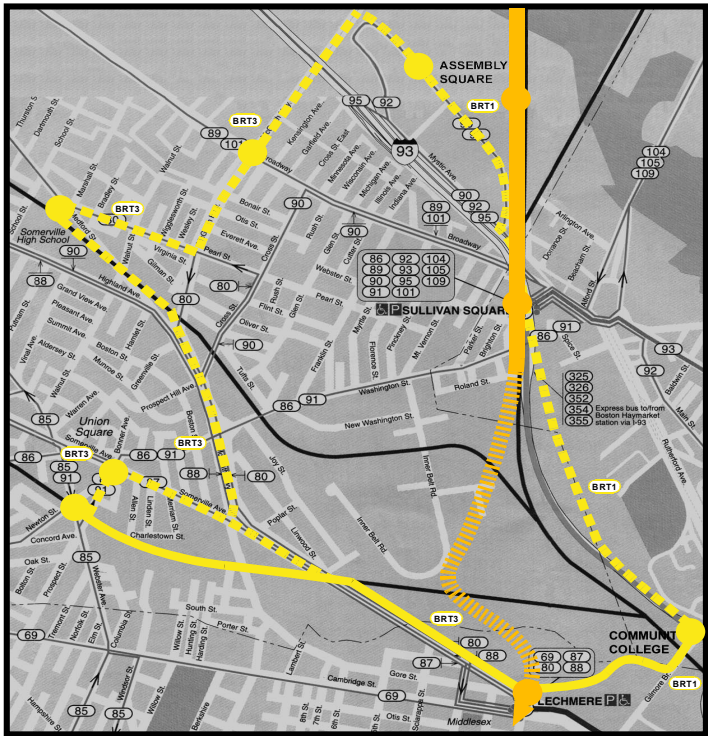


FIGURE 3-22
Somerville
Urban Ring Phase 3 – Alternative A2

Urban Ring Routes

- Heavy Rail Surface
- Heavy Rail Tunnel
- BRT Route Number
- BRT Mixed Traffic
- BRT Busway

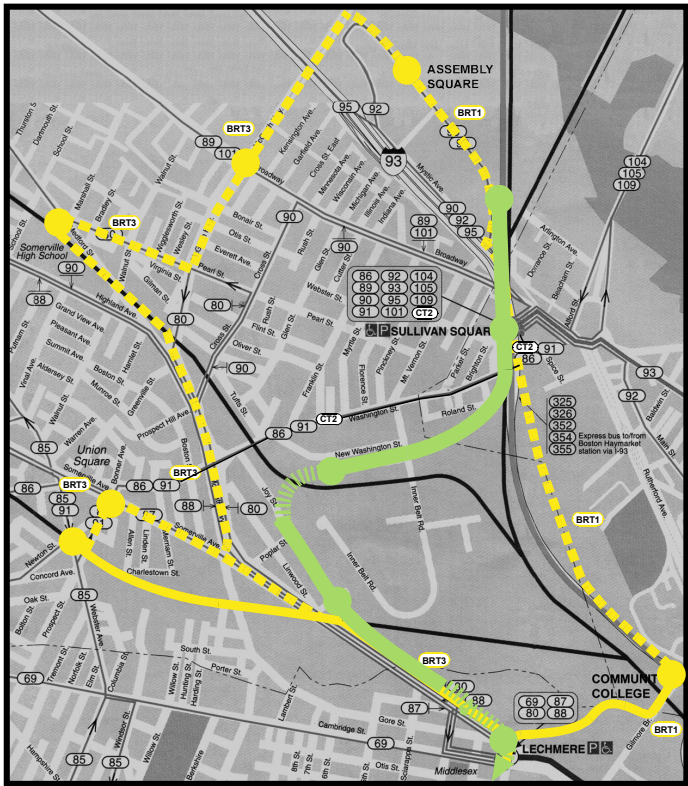
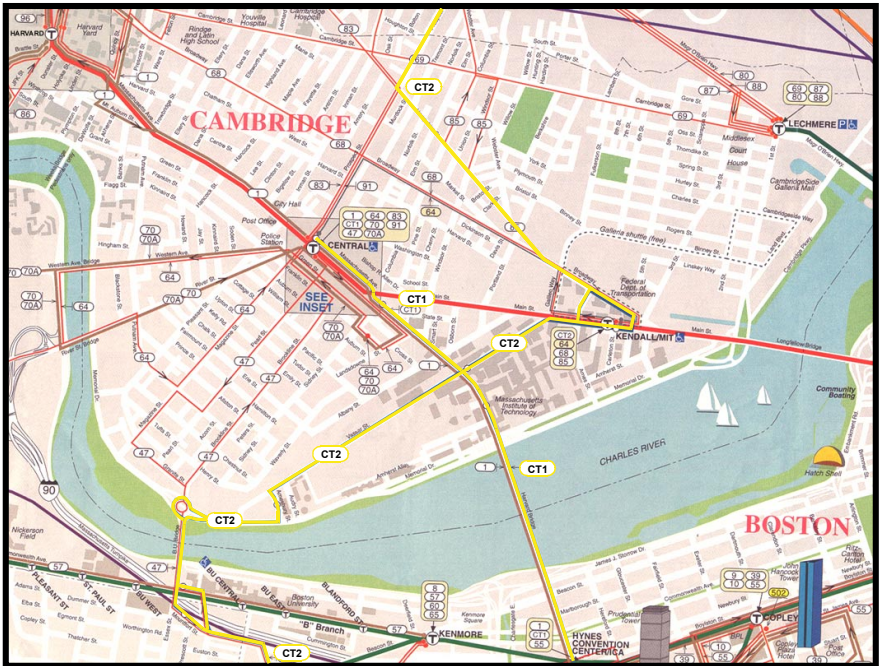


FIGURE 3-23
Somerville
Urban Ring Phase 3 – Alternative B

Urban Ring Routes

- LRT Surface
- LRT Tunnel
- BRT Route Number
- BRT Mixed Traffic
- BRT Busway

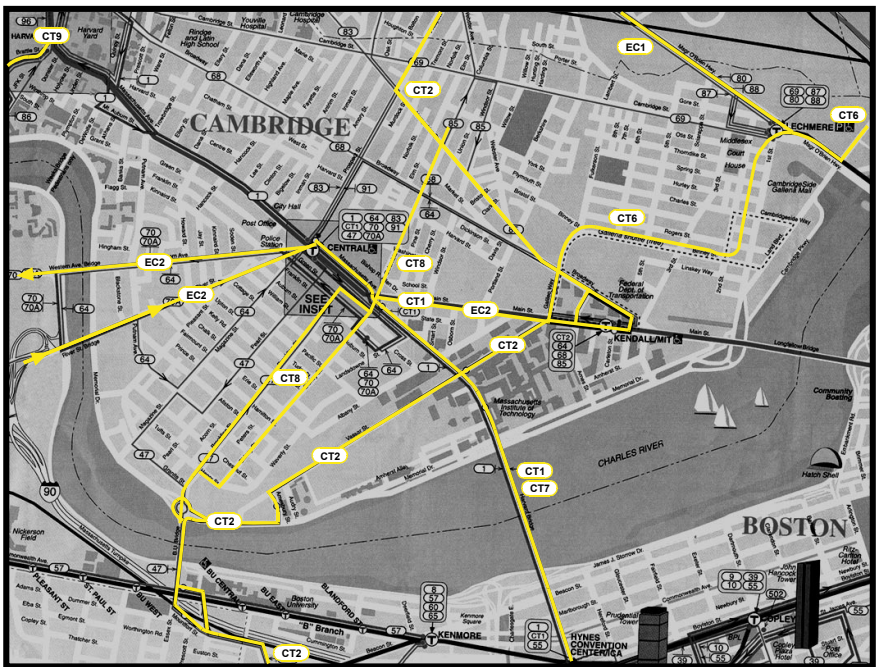
FIGURE 3-24
Cambridge
Existing MBTA Services



Existing Routes

- 16 Bus
- T Transit
- Commuter Rail
- CT2 Urban Ring Bus

FIGURE 3-25
Cambridge
Urban Ring Phase 1



Urban Ring Routes

- CT6 Urban Ring Bus Route

FIGURE 3-26
Cambridge
Urban Ring Phase 2

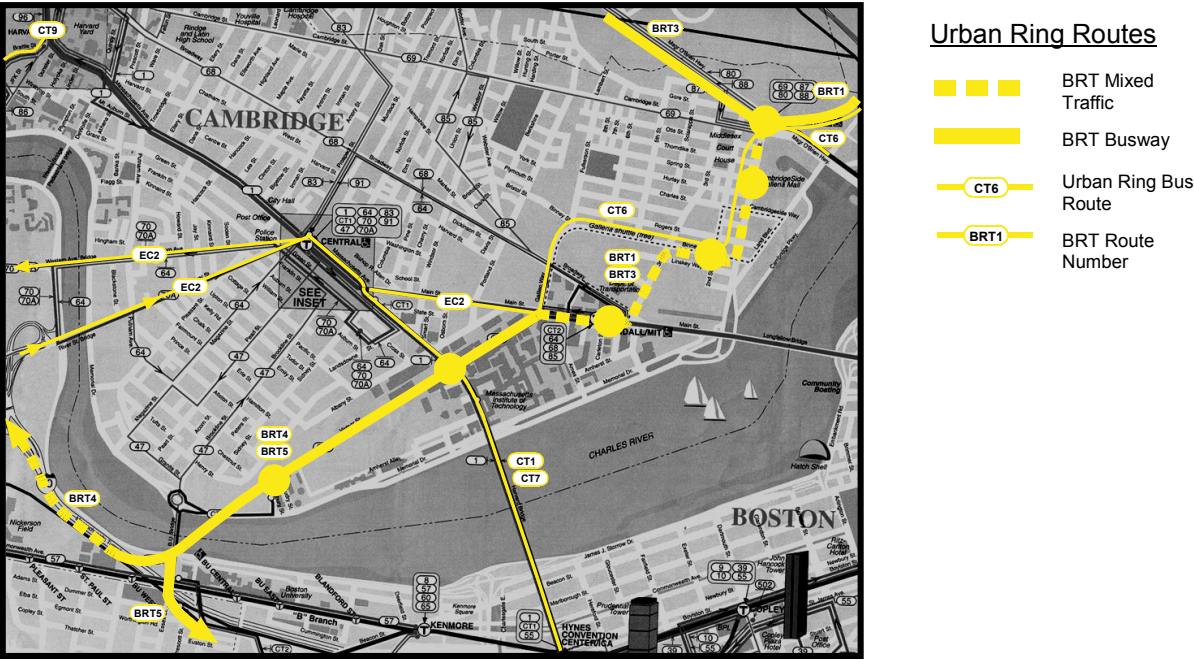


FIGURE 3-27
Cambridge
Urban Ring Phase 3 – Alternative A1

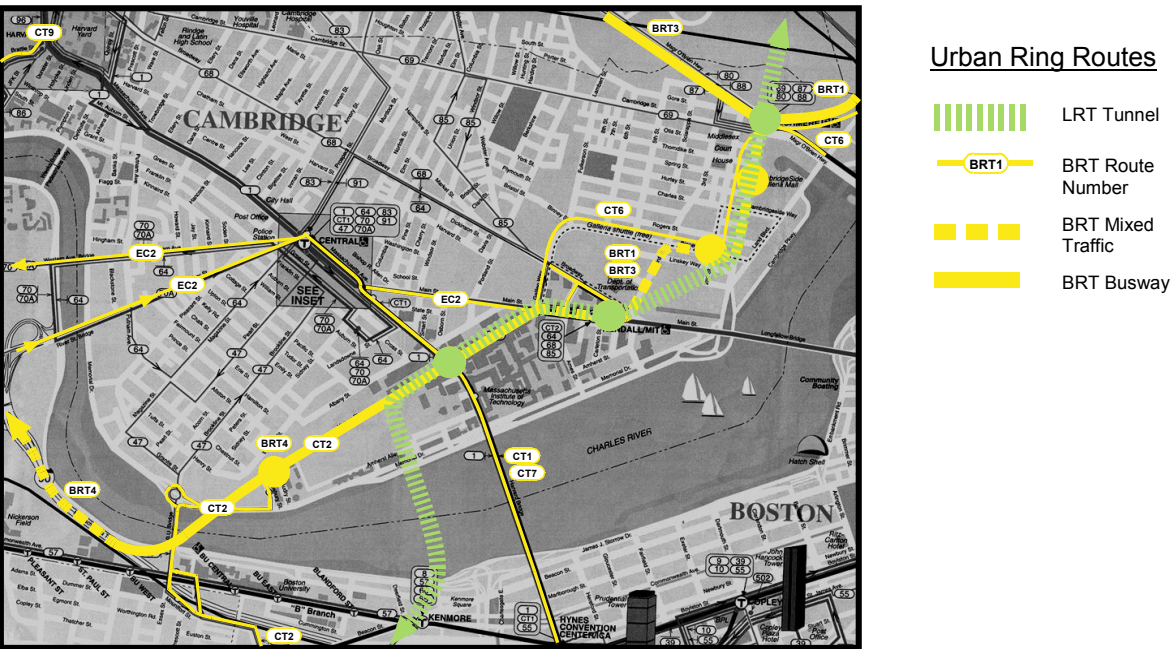
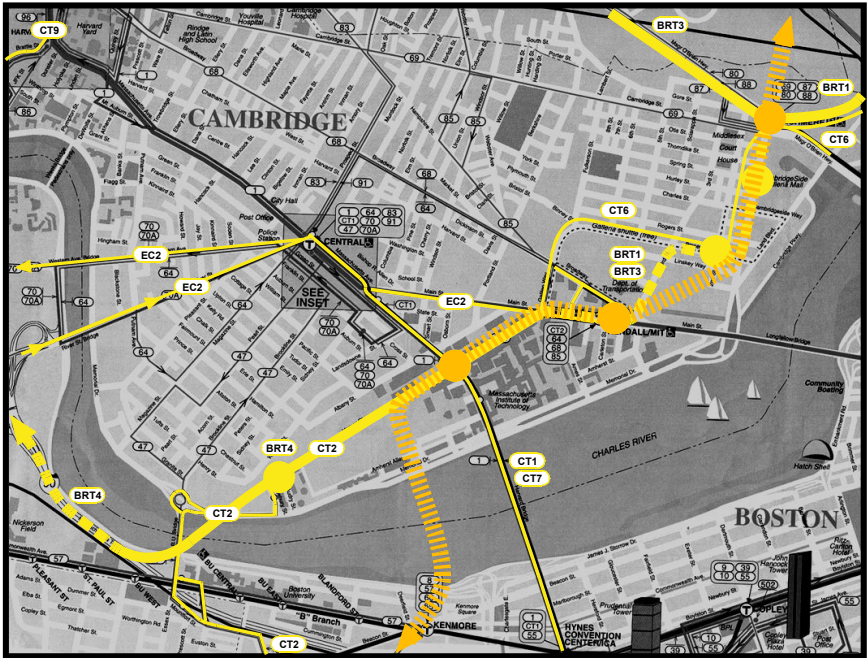


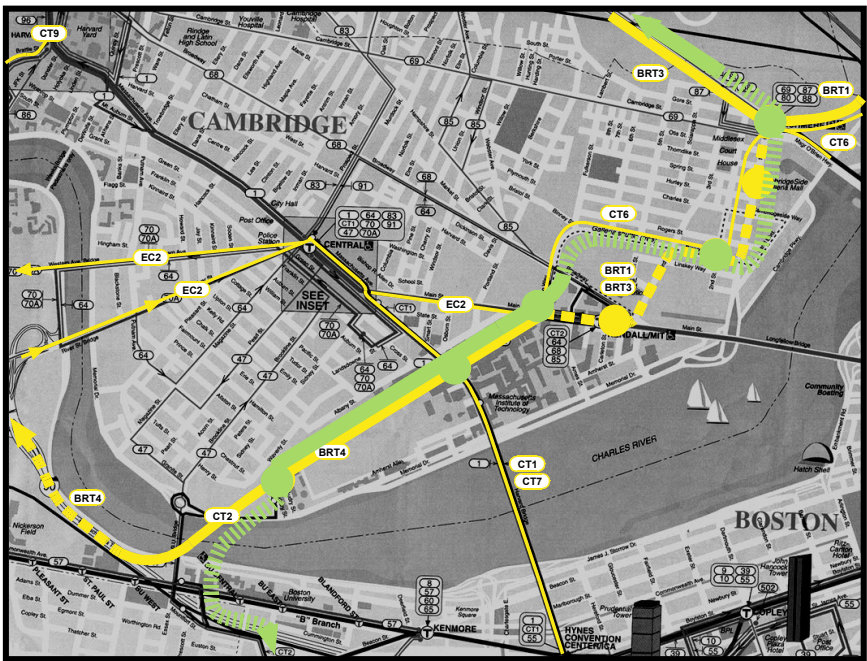
FIGURE 3-28
Cambridge
Urban Ring Phase 3 – Alternative A2



Urban Ring Routes

- Heavy Rail Tunnel
- BRT Route Number
- BRT Mixed Traffic
- BRT Busway

FIGURE 3-29
Cambridge
Urban Ring Phase 3 – Alternative B



Urban Ring Routes

- LRT Tunnel
- BRT Route Number
- BRT Mixed Traffic
- BRT Busway



FIGURE 3-30
Brookline and Boston
Existing MBTA Services

Existing Routes

- 16 Bus
- T Transit
- Commuter Rail
- CT2 Urban Ring Bus

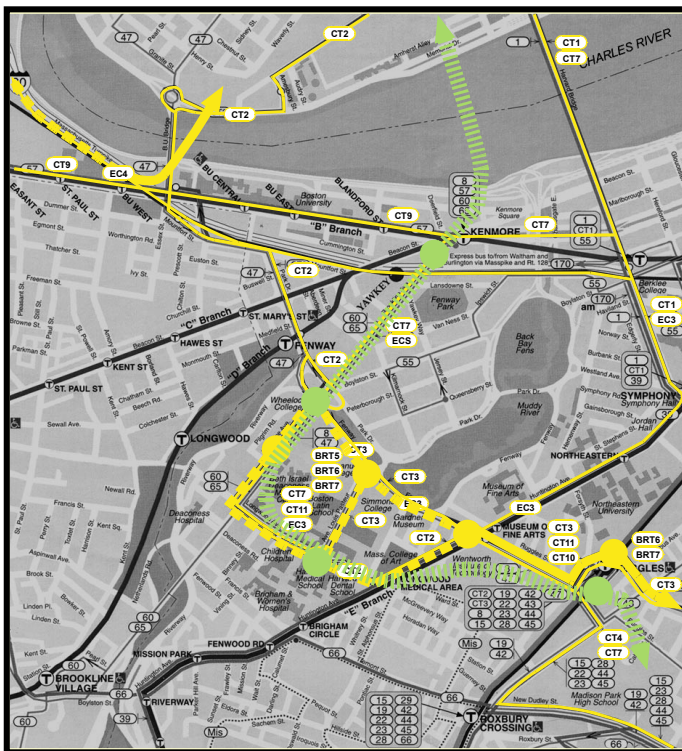


FIGURE 3-31
Brookline and Boston
Urban Ring Phase 1

Urban Ring Routes

- CT6 Urban Ring Bus Route

FIGURE 3-33
Brookline and Boston
Urban Ring Phase 3 – Alternative A1



Urban Ring Routes

-  LRT Tunnel
-  BRT Route Number
-  BRT Mixed Traffic
-  BRT Busway

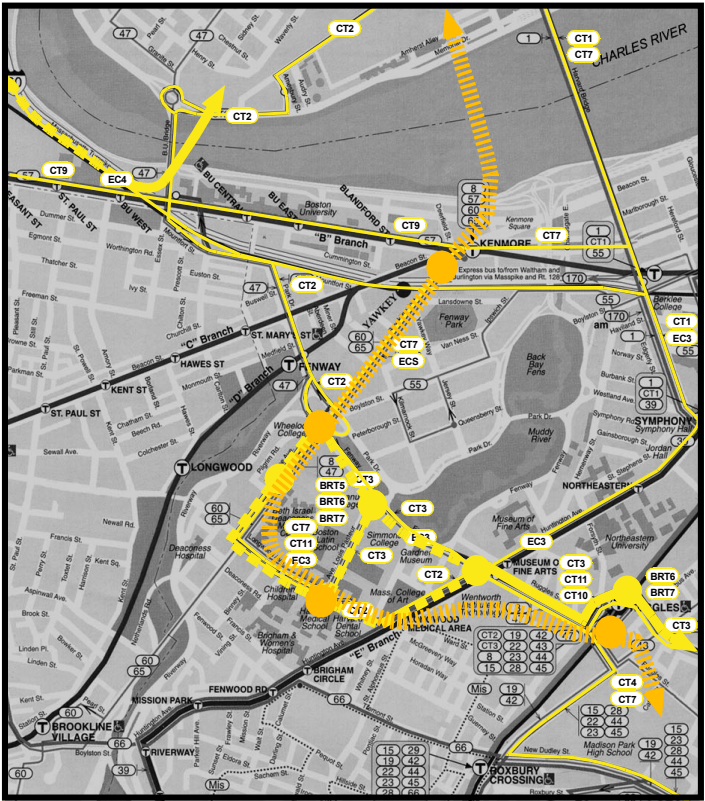


FIGURE 3-34
Brookline and Boston
Urban Ring Phase 3 – Alternative A2

Urban Ring Routes

- Heavy Rail Tunnel
- BRT Route Number
- BRT Mixed Traffic
- BRT Busway

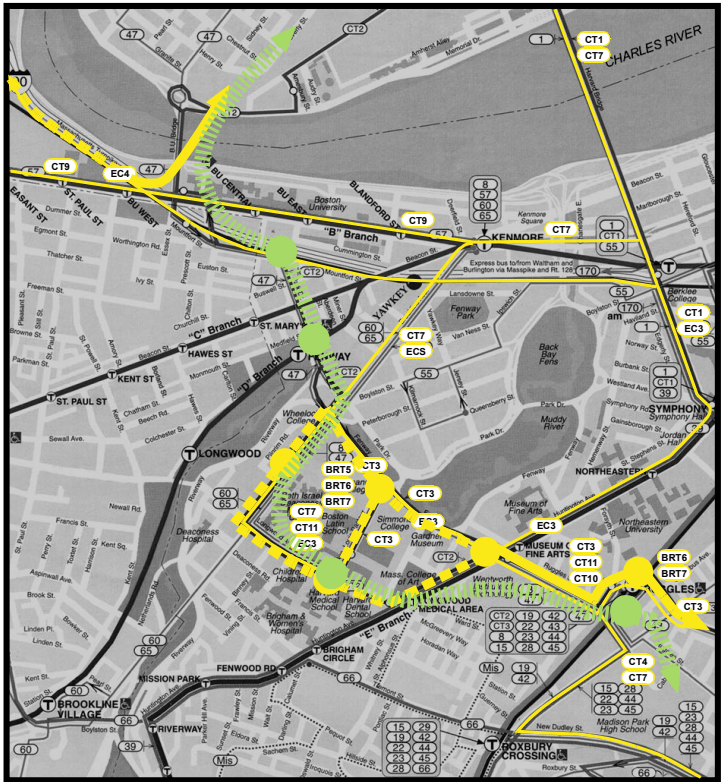


FIGURE 3-35
Brookline and Boston
Urban Ring Phase 3 – Alternative B

Urban Ring Routes

- LRT Tunnel
- BRT Route Number
- BRT Mixed Traffic
- BRT Busway

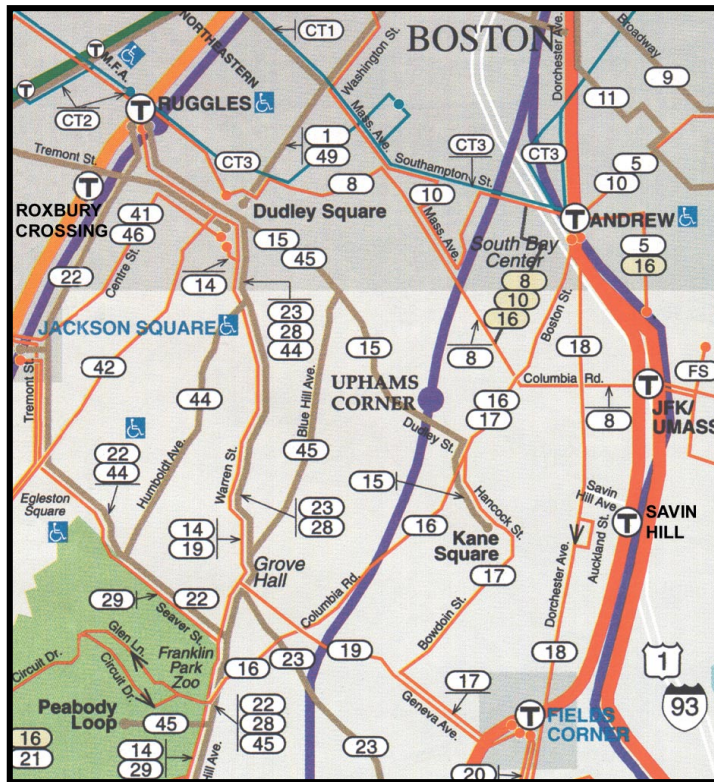


FIGURE 3-36
Roxbury and Dorchester
Existing MBTA Services

Existing Routes

-  Bus
-  Transit
-  Commuter Rail
-  Urban Ring Bus

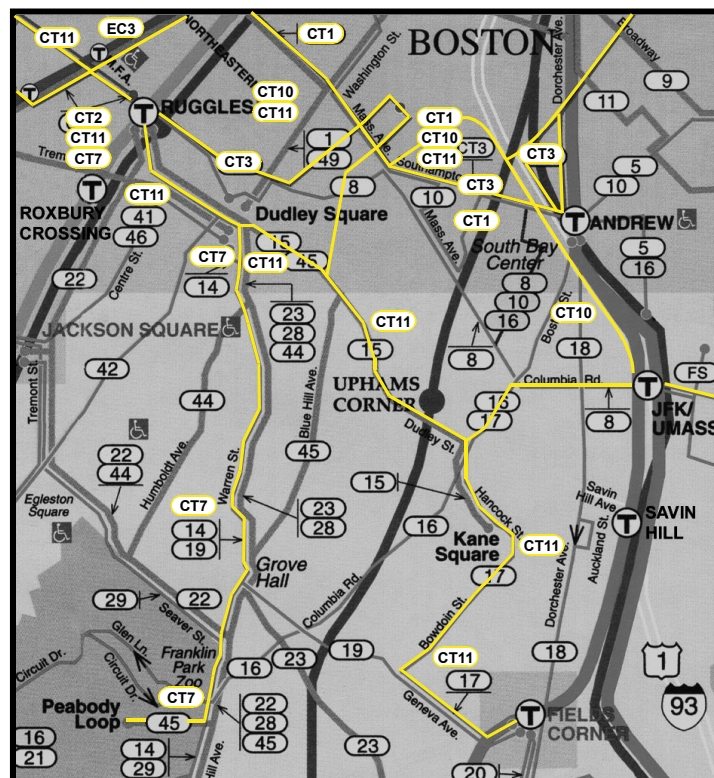


FIGURE 3-37
Roxbury and Dorchester
Urban Ring Phase 1

Urban Ring Routes

-  Urban Ring Bus Route

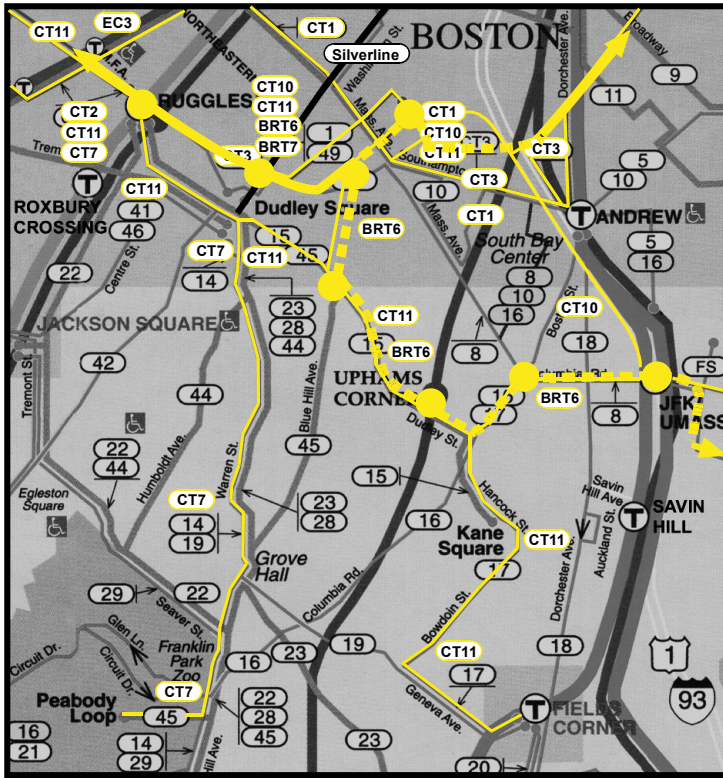


FIGURE 3-38
Roxbury and Dorchester
Urban Ring Phase 2

Urban Ring Routes

- BRT Mixed Traffic
- BRT Busway
- CT6— Urban Ring Bus Route
- BRT1— BRT Route Number

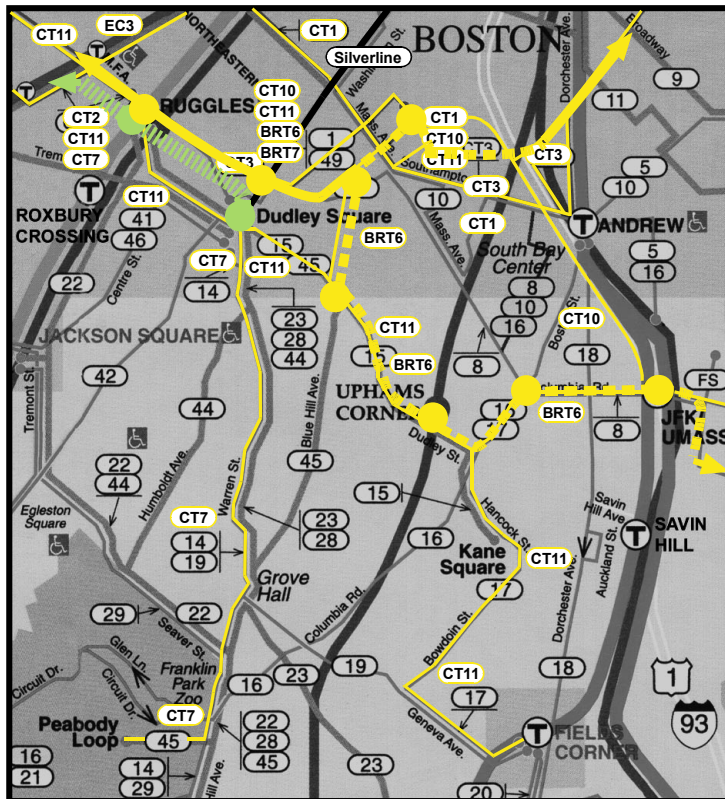


FIGURE 3-39
Roxbury and Dorchester
Urban Ring Phase 3 – Alternatives A1&B

Urban Ring Routes

- LRT Tunnel
- BRT1— BRT Route Number
- BRT Mixed Traffic
- BRT Busway

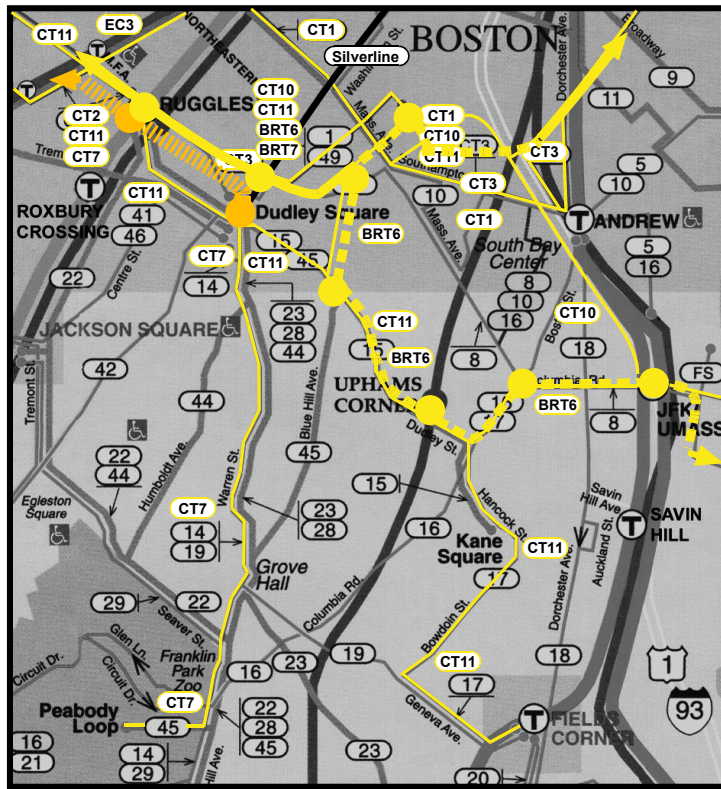


FIGURE 3-40
Roxbury and Dorchester
Urban Ring Phase 3 – Alternative A2

Urban Ring Routes

-  Heavy Rail Tunnel
-  BRT Route Number
-  BRT Mixed Traffic
-  BRT Busway



FIGURE 3-41
South Boston
MBTA Existing Services

Existing Routes

-  Bus
-  Transit
-  Commuter Rail
-  Urban Ring Bus

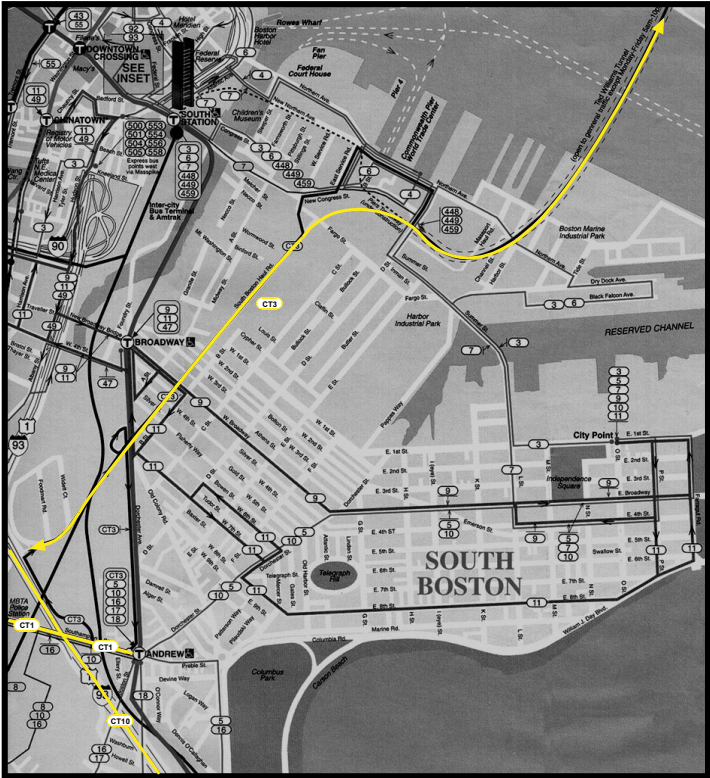


FIGURE 3-42
South Boston
Urban Ring Phase 1

Urban Ring Routes

- CT6 Urban Ring Bus Route

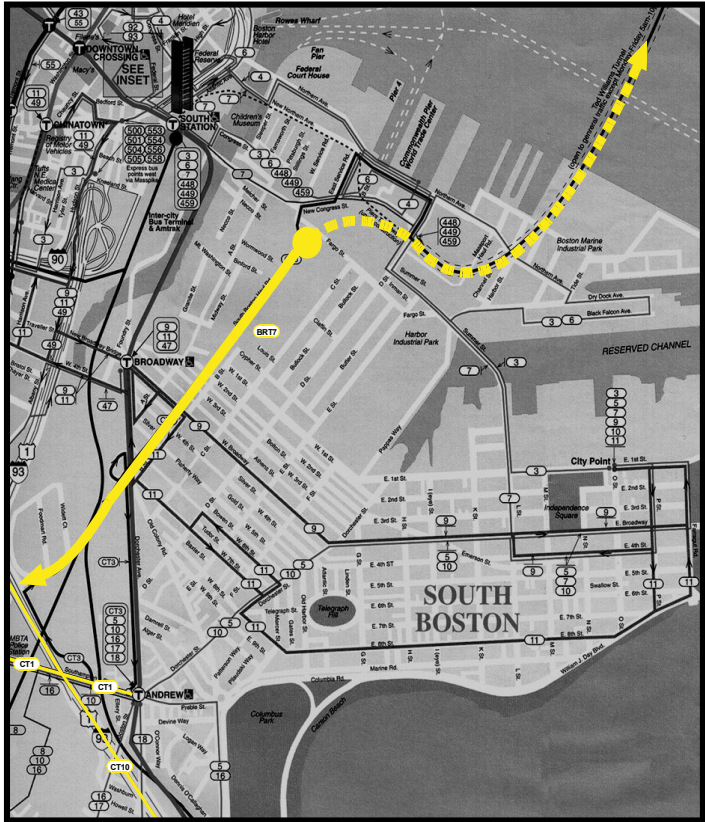


FIGURE 3-43
South Boston
Urban Ring Phase 2 and 3

Urban Ring Routes

- BRT Mixed Traffic
- BRT Busway
- CT6 Urban Ring Bus Route
- BRT1 BRT Route Number

Chapter 4

TRANSPORTATION IMPACTS

4.0 TRANSPORTATION IMPACTS

This chapter discusses the potential transportation impacts of the “No Build,” TSM, and “Build” Alternatives for the year 2025. It is organized around a comparison of the alternatives using the transportation performance measures adopted at the beginning of the MIS, as described in Chapter 1. Patronage forecasting and a variety of other model outputs provided by CTPS formed the basis of the analysis of transportation impacts. The detailed discussion includes the transportation measures of accessibility, transit ridership, transit system efficiency, transit congestion relief, impacts to the mobility impaired, non-motorized networks and roadway congestion.

Chapter 3 provides a detailed description of the routes, stations, services, headways and other characteristics of the Final Alternatives.

4.1 Summary Results

The transportation benefits of the Urban Ring start with implementation of the new and improved bus routes in Phase 1. The benefits increase significantly with the implementation of BRT routes and supporting elements of Phase 2, and are maximized in Phase 3 with the addition of rail in the most heavily traveled portion of the Corridor. A summary of the transportation impact findings for each of the Alternatives is provided below, followed by more detailed information organized within six categories of transportation benefits.

- Alternatives A1, A2, and B are projected to have at least 290,000 boardings per day in the year 2025 for the Rail, BRT and TSM bus elements combined. By comparison, TSM in Phase 3 would have approximately 50,000 daily boardings.
- Alternatives A1, A2 and B would save travelers approximately 50,000 hours per day compared to the 2025 “No Build” Alternative. Most of those time savings would be realized by existing transit users.
- The highest Urban Ring ridership would be in the core of the Corridor between the Orange Line at Assembly Square/Sullivan Square and the Silver Line at Dudley Square. This portion of the Corridor would, for the rail and BRT routes combined, have over 200,000 boardings per day for any of the build alternatives.
- The analysis of alternatives shows that ridership would drop off significantly south of Dudley Square regardless of alignment or technology.
- Alternatives A1, A2 and B would achieve reductions in central subway congestion by providing a faster and more direct route to reach Corridor destinations by transit.
- Alternatives A1, A2 and B would serve a large number of mobility-impaired households as measured by the number of households below the poverty line (over 17,000) and households without automobiles (over 35,000) within the station catchment areas of each alternative.

4.1.1 Accessibility and Mobility

The accessibility of the MBTA transit system to Corridor residents and workers will be greatly increased as a result of the Urban Ring alternatives due to the location of new and improved stations closer to transit users, and the greatly improved connectivity of the transit system. The figures and tables in Chapter 3 show that the Urban Ring connects with every existing and planned transit line in the MBTA system. Moreover, the Urban Ring also connects with half the local bus routes in the MBTA system providing an important feeder/distribution function by extending the reach of the higher quality Urban Ring service further into neighborhoods and employment centers.

The mobility of transit users, that is the speed of transit trips in the system, will also be greatly improved by the Urban Ring alternatives. At a system-wide level Alternatives A1, A2, and B would save approximately 50,000 hours per day of travel time compared to the No-Build Alternative. Table 4-1 provides a detailed breakdown of the daily travel time savings by mode and alternative. Approximately 75 percent of the daily travel-time savings will be realized by existing transit users, and the remainder by non-transit users such as autos and trucks due to fewer vehicles on the road. The projected travel-time savings are similar for each of the alternatives. The travel-time savings for transit users are evenly divided between in-vehicle and out-of-vehicle time. The shorter, more direct Urban Ring routes result in less time spent within a transit vehicle to complete Corridor trips. The out-of-vehicle travel-time savings will result from the convenient accessibility of the Urban Ring LRT and BRT station stops, as well as the high frequency of service. More frequent service means less time waiting in a station for a transit vehicle to arrive.

For specific trips to and from the Corridor the magnitude of the travel-time savings is even more pronounced. Seven example origin-destination pairs representing various areas of the Corridor and types of trips were analyzed to determine the travel-time savings for individual one-way transit trips. The examples include trips internal to the Corridor as well as trips to Corridor destinations from elsewhere in the Region. For both types of trips the Urban Ring will provide significant measurable travel-time savings. Out-of-vehicle waiting time in the examples was calculated as one-half the scheduled interval between arrivals of the transit vehicle. For example, if the transit vehicle is scheduled to arrive every 30 minutes the average wait time used in the calculations would be 15 minutes, if every 60 minutes the average wait would be 30 minutes, and so forth.

The analysis compared the “No-Build” trip time to the trip time that would be achieved with the Urban Ring. Table 4-2 summarizes the results of this analysis for the example trips in with BRT as well as in Alternatives A1 and B. The results show dramatic improvements in transit trip times with the Urban Ring for the example trips. Example travel-time savings for Alternative A2 were not calculated, but can be expected to be similar to those of Alternative A1 for most trips due to their similar alignments and station locations. For the example origin-destination pairs, the travel-time savings are attributable to one or more of the following features of the transit system with the Urban Ring service compared to the transit system without it:

- Routing within the Corridor is more direct
- Average speed of transit vehicles is higher
- Some transfers are eliminated and others made more direct
- Frequency of service is higher
- Connections with radial transit and commuter rail enable trips to bypass downtown Boston

In Phase 2 the example travel-time savings ranged from 6 minutes to 20 minutes each way. For the Downtown Chelsea to Logan Airport example the Urban Ring Phase 2 transit travel-time savings of 20 minutes represents a 53 percent reduction in transit travel time for this trip compared to the No-Build case.

In Phase 3 the example travel-time savings ranged from 9 minutes to 28 minutes each way. For the Dudley Square, Boston to Kendall/MIT, Cambridge example the Urban Ring Phase 3 travel-time savings of 28 minutes represents a 58 percent reduction in transit travel time for this trip compared to the No-Build case.

Travel-time savings for trips to Corridor destinations from elsewhere in the region also benefit from the Urban Ring service. In Phase 2 for the Lynn to Logan Airport example the Urban Ring transit travel-time savings of nearly 13 minutes represents a 28 percent reduction in transit travel-time savings for this trip

compared to the No-Build case. In this example the trip would use commuter rail from Lynn to Chelsea and transfer to the frequent Urban Ring BRT service at Chelsea for the trip to Logan Airport along a route separate from the local streets of Chelsea and East Boston.

Each of the Phase 3 alternatives would increase daily systemwide transfers by amounts ranging from 45,000 per day in Alternative A1, to 51,000 in Alternative B, and 63,000 in Alternative A2. These transfers represent approximately 6-8 percent of total systemwide transfers per day, but will be occurring primarily outside the congested central subway system.

4.1.2 Daily Ridership

Projected daily ridership for the Urban Ring final alternatives is substantial and grows incrementally by phase as each new component of service is added. Figure 4-1 depicts the Urban Ring daily ridership by phase. Discussion of the ridership results by phase and alternative is provided below. Refer to Table 4-3 for details on daily ridership by phase, transit mode, and route.

4.1.2.1 Phase 1 Ridership

Daily ridership on the Urban Ring is expected to be 40,300 in Phase 1 on the new and improved crosstown and express buses. Of the two types of service, most of the ridership is associated with the crosstown bus routes. The eleven crosstown routes would carry a total of 34,720 riders per day, which is an average of almost 3,200 daily riders per crosstown route. The geographic reach of these crosstown routes enables them to attract riders not well served by the existing system. The express routes are primarily radial and attract fewer riders than the crosstown routes because, for the most part, the radial market is already well served by existing transit and commuter rail. The three express routes studied would have total daily ridership of 5,580, primarily on just two of them. The projected ridership on the third route (EC3) is only 430 per day and thus it is not recommended for implementation. Ridership on the two remaining express routes can be attributed to their ability to provide certain origin destination pairs with single seat rides between the suburbs and the Corridor.

4.1.2.2 Phase 2 Ridership

Implementation of the BRT routes and improved radial connections in Phase 2 builds upon the Phase 1 service and increases total Urban Ring daily ridership to 106,000. As shown in Table 4-3, the crosstown and express bus ridership would be 21,250 per day, nearly all of which would be on the crosstown routes. The EC1 route would be discontinued in Phase 2 because the commuter rail to BRT connection at Sullivan Square would provide this service. As described in Chapter 3, a number of the Phase 1 crosstown bus routes (CT2, CT3, CT4, CT5, CT8) are no longer needed in Phase 2 because their markets would be served by the new BRT routes.

The seven BRT routes in Phase 2 are projected to have 84,750 combined daily riders. Average ridership per BRT route would be over 12,000 per day. The highest ridership for a single BRT route would be BRT1 in the northern portion of the Corridor with over 34,000 daily riders. The two lowest ridership routes would be BRT6 and BRT7 located in the southeastern portion of the Corridor with less than 5,000 riders each. More typical is the ridership projected on the other four routes which ranges from around 9,000 to 12,000 per day.

4.1.2.3 Phase 3 Ridership

The addition of rail transit service in Phase 3 builds daily ridership to approximately 290,000, depending upon the rail transit alignment and technology chosen. Projected total Urban Ring daily ridership for Alternatives A1, A2 and B is substantial. The totals are approximately 282,500 for Alternative A1; 289,350 for Alternative A2; and 293,800 for Alternative B. The totals include approximately 10,000 daily transfers between Urban Ring transit modes as estimated by CTPS. While the overall totals are similar, the transit-mode breakdowns differ.

As shown in Table 4-3, the crosstown and express bus ridership would be approximately 5,000 less per day in Alternatives A1 and A2 than it would be in Alternative B. This is attributable mainly to the CT7 bus route ending at Dudley Square in Alternatives A1 and A2 whereas in Alternative B the CT7 bus route would continue all the way to Kendall Square. The analysis shows there may be advantages to keeping the CT7 route intact in Phase 3 regardless of the rail alignment chosen. The BRT component of the Phase 3 ridership is also similar for Alternatives A1 and A2 with Alternative B having lower BRT ridership. The reason is primarily the dynamic between the BRT3 route and how the A1 and A2 rail alignment and station location would differ from Alternative B in Somerville toward the west end of Washington Street. The rail alignment used in Alternatives A1 and A2 is more distant from the west Washington Street area. Therefore, in Alternatives A1 and A2 more ridership from the area of west Washington Street would use the BRT3 route. In Alternative B, the rail alignment and station would be closer to west Washington Street and would attract more ridership than the BRT3 route in this area.

The rail component of projected daily ridership in the year 2025 is 203,850 for Alternative A1; 206,300 for Alternative A2; and 215,300 for Alternative B. The rail ridership shown for Alternatives A1 and B are comprised of the combined ridership on two separate LRT routes. Route LRT1 would operate between Assembly Square in Somerville and Dudley Square in Boston. Route LRT2 would operate between Medford Hillside (on the planned Green Line Extension) and join the Urban Ring alignment just west of New Lechmere, and service would overlap the LRT1 route from New Lechmere to Dudley Square.

The difference in how the LRT1 and LRT2 ridership breaks down in Alternative A1 and B is mainly attributable to how the LRT1 route differs between Sullivan Square and New Lechmere. In Alternative B the Urban Ring routes LRT1 and LRT2 run parallel to each other between Washington Street and New Lechmere and the ridership in that area would be divided between the two routes. In Alternative A1 the LRT1 route takes the more direct alignment between Sullivan Square and New Lechmere and thus nearly all the rail ridership in the area between Washington Street and New Lechmere would be attracted to the LRT2 route.

In Alternative A2 there is a single heavy rail transit route identified as HRT1 with 206,300 daily riders operating as a branch of the Orange Line between Wellington station in Medford and Dudley Square in Boston. Chapter 3 contains a more detailed description of the alignments, stations, and operating plan for the Urban Ring services at each phase.

4.1.2.4 Systemwide Transit Ridership

The Urban Ring alternatives are effective at building transit ridership primarily by diverting automobile trips to transit. Additionally, some existing walk trips would be diverted to transit. In both cases the diversions are due to a number of factors, including the greater accessibility of stations and more attractive trip times provided by the Urban Ring services. Each phase of the Urban Ring would result in significant increases in the number of systemwide linked transit person trips compared to the No-Build. Compared to No-Build at each phase, Phase 1 TSM would increase systemwide ridership by 6,600 and Phase 2 would increase it by 15,000. By Phase 3, each of the alternatives are projected to result in approximately 47,000 additional linked transit person trips in the system per day. In addition to gaining substantial new transit riders, the Urban Ring alternatives would divert even larger numbers of existing transit users from other lines in the MBTA system due to superior trip times. The North and South Side Commuter Rail Lines would together experience an increase of over 17,000 riders per day compared to the 2025 No-Build. These increases would be attributable to the new commuter rail stations that are part of these alternatives to facilitate easy transfer between commuter rail and the Urban Ring service.

4.1.2.5 Urban Ring Ridership by Geographic Segment

The Corridor was divided into five geographic segments to provide a better understanding of how the Phase 3 alternatives compare at a more localized level. Few Urban Ring trips would ride along the entire length of the Corridor because, past a certain point, such trips can be made more efficiently on the radial system. The shortest distance for trips to opposite sides of a circle (the Ring) will continue to be straight through the Core. Breaking the Corridor into five geographic segments facilitates understanding the

ridership within the sub-markets of the Corridor, and enables comparison of Phase 3 alignment and technology choices within each segment.

Figure 4-3 depicts the five geographic segments. A breakdown of the Urban Ring ridership by geographic segment is provided in Table 4-4. The table shows that in Phase 3 the ridership is concentrated in Segments 2 and 3, which correspond to the central portion of the Corridor between Assembly Square and Ruggles. The next highest ridership is within Segment 1 which is the northern portion of the Corridor between East Boston and Wellington. Segments 4 and 5, which is the area south and east of Ruggles to JFK/UMass and through South Boston, show relatively low ridership compared to Segments 1, 2, and 3.

In Segment 1, Alternative A2 is projected to have higher boardings than Alternatives A1 and B because, as the heavy rail alternative, A2 would serve Wellington with Urban Ring rail service operating as a branch of the Orange Line. The higher boardings are attributable to the Wellington rail service and the more attractive connections that rail service would provide to BRT routes at Wellington.

In Segment 2, Alternatives A1 and B are projected to have higher boardings than Alternative A2 primarily because both A1 and B would interline with the Green Line Extension to Medford Hillside and operate as a Branch of the Green Line. The Segment 2 boardings shown for Alternatives A1 and B include boardings from all stations along the Green Line Extension on Urban Ring route LRT2 which actually extends beyond the Segment 2 boundary shown on the map.

In Segment 3, Alternative B is projected to have somewhat higher boardings than Alternatives A1 and A2 primarily because it would have a total of six rail stations in this segment compared to five rail stations with Alternatives A1 and A2.

In Segment 4, Alternatives A1 and A2 are projected to have higher boardings than Alternative B primarily due to higher projected rail boardings at Dudley Square.

In Segment 5, the boardings shown are for a single BRT station located at the new Convention Center. A sensitivity analysis was conducted for an optional route using I-93/I-90 instead of the South Boston Haul Road, and a station location at the Federal Courthouse rather than the Convention Center. The results showed the optional route and station would result in longer trip times and lower ridership than the proposed route that, similar to the existing CT3 route, would use the Haul Road.

4.1.3 Transit System Efficiency

A major problem identified during this study, as well as during previous studies, is the growing disconnect between regional and Corridor travel patterns and the existing transit system. The radial configuration of the existing transit system is not efficient or effective at serving the crosstown travel market. At each phase, the Urban Ring alternatives would progressively boost transit system efficiency by providing direct routing between transit origins and destinations that currently require transfers in the central subway system. Utilization of existing infrastructure is an important measure of efficiency, and each of the BRT and A1, A2, and B alternatives will make use of underutilized active and abandoned rail and roadway rights-of-way along their routes. Alternative A2, which uses Heavy Rail Transit, is notable in this regard because it would interline with the existing Orange Line at Sullivan Square, utilize the existing second center platform, the existing third track (currently used for testing cars) between Sullivan Square and Wellington. Moreover, Alternative A2 could utilize the existing Wellington maintenance facility which has sufficient capacity and room for expansion to handle the Urban Ring Heavy Rail vehicles.

4.1.4 Transit Congestion

Transit congestion – crowding and delays in the central subway system – is a chronic problem that will be only partially addressed by capacity improvements contained in the current Regional Transportation Plan. Even with planned improvements such as using three car trains it is conservatively estimated that the Green Line will reach a demand to capacity ratio of 1.4 to 1 (40 percent over capacity) in the peak hour by

the year 2025¹. The projected congestion on the Green Line would be even worse if the assumed 1-1/2 minute peak period headways in the central subway are lengthened due to use of three-car trains. However, with the Urban Ring, tens of thousands of daily transit trips that would otherwise be forced to pass-through the central subway will instead choose the faster and more direct Urban Ring service that bypasses downtown Boston.

Alternatives A1 and B would reduce peak hour maximum load point volumes on the Green Line down to levels 4 percent above capacity, while Alternative A2 would bring congestion down to 17 percent above capacity. Alternatives A1 and B would operate as a branch of the Green Line in tandem with the Green Line Extension to Medford Hillside, and therefore are able to divert a higher number of Green Line riders from the central subway. Congestion problems forecast for the other radial transit lines are less severe than the Green Line, though the same principle applies. The Urban Ring service would also divert transit trips from the Red Line and other radial transit lines. Removing pass-through transfers from the central subway system enables more of its limited capacity to be used for serving Downtown Boston and the radial markets. Thus, the alternatives would create new transportation capacity for the region while freeing capacity for the central subway.

Figure 4-2 depicts the projected daily boardings by line of service in the MBTA system with and without the Urban Ring rail system in the year 2025. It shows the significant reduction in volume on the radial transit and bus lines, particularly on the Green Line, that is achieved with the Urban Ring. The specific impact of the individual alternatives (A1, A2, and B) differs primarily with regard to the Green and Red Lines. Alternatives A1 and B which would interline with the Green Line at New Lechmere would reduce Green Line congestion somewhat more than Alternative A2 which would interline with the Orange Line at Sullivan Square. Alternatives A1 and B would reduce 2025 peak hour Green Line volumes to slightly below peak hour capacity while Alternative A2 would reduce those volumes to just meet capacity.

Figure 4-4 is a traffic density map depicting daily passenger volume on the Green Line in the base year 1995. Figure 4-5 depicts the projected Green Line volume in the future, using the 2025 “No-Build” scenario in the absence of the Urban Ring. A comparison of the two shows tremendous growth is expected in the already congested central subway portion of the Green Line. Figures 4-6, 4-7, and 4-8 show the extent to which the Urban Ring Phase 3 Alternatives A1, A2, and B would each reduce Green Line passenger volumes in the congested Core of Boston in the Year 2025. The reduction in Green Line congestion achieved by the Urban Ring service would effectively extend the capacity of the Green Line well into the future while providing more direct routing for passengers travelling along the fast growing Urban Ring Corridor.

4.1.5 Impacts to the Mobility Impaired

A major benefit of all of the Urban Ring “Build” Alternatives is the positive impact they would have on transit service for households that are mobility-impaired due to low income and/or lack of access to an automobile. The analysis contained in Chapter 6 shows that the Corridor contains a large percentage of low-income households and households without automobiles, both of which are general indicators of transit dependency. The station catchment area analysis contained in Chapter 6 shows the large number of transit-dependent households that each of the Phase 3 Alternatives would serve. Each of the alternatives would provide access to large minority populations as well. Based on Year 2000 Census data there were between 115,000 and 118,000 minority residents within the catchment areas of the Urban Ring stations. Minorities represent 51 percent of the total population within these catchment areas in Year 2000.

The number of households below the poverty level is one of the criteria used to measure environmental justice. Presidential Executive Order 12898, issued in 1994, directed every federal agency to make environmental justice part of its mission by identifying and addressing the effects of all programs, policies, and activities on “minority populations and low-income populations.” As such, the FTA is examining the effects that federally funded projects will have on these communities. In support of the Executive Order,

¹ Source: CTPS - June 2001

the Executive Office of Environmental Affairs of the Commonwealth of Massachusetts (MEPA) issued a draft Environmental Justice Policy in December 2000. The public comment period for this document closed July 2, 2001 and MEPA is currently reviewing comments received from the public. It is expected that a final version will be adopted later this year.

The purpose of this policy is the support of environmental justice for all residents of Massachusetts. As a project seeking support from both the Commonwealth of Massachusetts and the FTA, the Urban Ring MIS is identifying the environmental justice effects of the Urban Ring. One factor measuring environmental justice concerns is the impact of the project on households below the poverty level. There are large numbers of households within the station catchment areas of Alternatives A1, A2 and B that can be categorized as mobility impaired due to low-income level or lack of access to an automobile. Each of these alternatives would significantly improve transit access for such households. Based on 1990 census data, Alternative A1 station catchment areas contained 17,204 households below the poverty line and 35,314 households without an automobile. By comparison, Alternative A2 had nearly identical 17,235 households below the poverty line and 35,372 households without an automobile.

These positive impacts on mobility can be grouped into benefits for travel within the Corridor and benefits for travel between the Corridor and the balance of the region.

4.1.5.1 Travel Within the Corridor

The lack of circumferential connections in the Corridor has significant implications for accessibility within both the Corridor and the larger region, particularly for the mobility impaired. Access among activity centers in the Corridor and to origins and destinations elsewhere in the region for these populations is often circuitous and slow using public transportation. The existing options on the transit network include use of the crosstown bus network, which suffers from the limitations of the roadway network, or circuitous routing via the congested radial rapid rail and LRT network and a transfer between lines in the Boston Inner Core. Each of the Alternatives would significantly reduce transit trip times between concentrations of transit dependant population and centers of health care, higher education and employment.

Table 4-2 shows the travel time improvement achieved for several example origin-destination pairs and these travel time benefits would occur in transit dependant neighborhoods throughout the Corridor.

4.1.5.2 Travel Between the Corridor and the Region

The Urban Ring Alternatives each provides the benefit of convenient transfers between the Urban Ring service (rail and BRT) and the commuter rail system and radial transit system. The result is a significant increase in the accessibility of the commuter rail system and the radial transit lines to transit dependent populations within the Corridor, thereby providing improved mobility to employment opportunities at the growing number of suburban locations served by commuter rail.

4.1.6 Non-Motorized Network

The non-motorized transportation network includes pedestrian travel and bicycles. The Phase 1 Alternative would add new conventional bus routes operating throughout the Corridor in mixed traffic and has relatively low impact on transit mode share. It can be expected that Phase 1 would not have any significant impact on the non-motorized transportation network.

In Phase 2 several segments of exclusive BRT busway and bus lanes will be constructed and the transit mode share is projected to increase due to the faster travel times and more frequent service.

Alternatives A1, A2, and B provide rail in an exclusive tunnel or surface easement at least within the central portion of the Corridor between Assembly Square and Dudley Square. Each of these alternatives would include facilities to accommodate bicycles at stations and the distribution of the stations would enable a greater portion of the transit system to be accessible by bicycle. It has not yet been determined whether the LRT, Heavy Rail, and/or BRT vehicles would accommodate carrying bicycles.

The pedestrian network would benefit from localized reductions in vehicular traffic. Increased accessibility of transit stations would bring the transit system within walking distance of areas currently requiring an auto drop-off, feeder bus ride or private shuttle trip. The full or partial grade separation featured in combination with the new accessible stations that would be built under those alternatives, would result in benefits to the pedestrian and bicycle network within the Corridor compared to the TSM or "No Build" Alternatives.

4.1.7 Roadway Congestion

The radial network of expressways and arterials and local network of crosstown arterials within the Corridor and adjacent Boston Core, both experience the highest and most concentrated levels of traffic congestion of any facilities in the region. Corridor generated travel demand is a significant contributor to this congestion. Roadway congestion on the radials is worsened by the large volume of trips to and from points in the Corridor. Inner radial roadway and Boston Core congestion is worsened by the pattern of "in and out" travel associated with many of the vehicle trips generated by Corridor activities. Finally, the high congestion levels on the limited crosstown arterial network are the result of trips generated within the Corridor.

As a result, transportation improvements that divert Urban Ring trips to new circumferential facilities can reduce the growth in congestion and free roadway capacity for other regional and local trip making.

4.1.7.1 Traffic Impacts

Traffic impacts of the Urban Ring alternatives were assessed under two major categories: first, operational impacts and, second, impacts due to changes in travel patterns. Operational impacts are those associated with the physical elements of each alternative, such as new grade crossings which could increase traffic delay compared to No Build conditions. Changes in travel patterns, specifically change in travel mode from auto to transit, could result in reductions in traffic volumes compared to No Build conditions. General impacts for each category are described below.

◦ Operational Impacts

The operational impacts of each alternative largely depend on the extent of separation from general traffic, route alignment and vehicle headways. In terms of impacts to traffic, operations can be characterized into the following three types. Other than TSM, which would always utilize buses operating in mixed traffic, each of the other Alternatives is a combination of all three characteristics. In the highest density areas of the Corridor, such as in East Cambridge and Longwood Medical Area, the BRT routes would overlap with the Phase 3 rail service. This is not expected to cause a problem at LMA because the rail service would be operating in an exclusive tunnel through this area. In East Cambridge, the feasibility of overlapping the rail and BRT operations between Kendall Square and New Lechmere will depend on the LRT alignment and profile. LRT or Heavy Rail operations in tunnel would not interfere with BRT operations. However, LRT operations at-grade as would be necessary in Alternative B could interfere with overlapping BRT operations that are planned to use these streets, particularly along the Mid-Block Connector Street and Main Street near the Kendall Square.

The BRT routes, which involve buses operating in mixed traffic as well as in busways, also include various physical improvements, such as bus lanes, signal priority and local roadway/intersection improvements to facilitate the flow of the buses. These physical improvements will have varying minor impacts to traffic operations. Bus lanes will have minor to moderate impacts to traffic operations where they join/cross general traffic or where portions of general traffic lanes are eliminated, whereas local roadway/intersection improvements will generally result in improvements for all traffic operations. Traffic signal priority will result in a slight improvement in traffic operations along the major roadways but could result in a slight decrease in traffic operations along intersecting minor roadways.

- ***Transit vehicles operating in mixed traffic***

This type of operation will generally have an insignificant impact to traffic operations. Proposed peak hour headways of ten minutes will result in 6 buses per hour in each direction. Areas where routes overlap would experience 12 buses per hour in each direction. Station stops along the routes are limited to key activity centers and will often have facilities that allow buses to pull out of the traffic stream. The addition of relatively small numbers of vehicles, in combination with the characteristics of the service, will result in little to no impact on local traffic operations.

- ***Transit vehicles operating in an exclusive at-grade facility***

Vehicles traveling at-grade in an exclusive facility will have a varying impact to traffic operations where the at-grade facility crosses existing roadways. Depending on the volume of traffic on the roadway crossed by the new facility and the relationship of the facility to the local roadway network, an at-grade crossing activated approximately every five minutes in each direction would result in minor to moderate localized impact to traffic operations.

- ***Transit vehicles operating in an exclusive bridge or tunnel facility***

Vehicles traveling in a tunnel or bridge facility have no interaction with the roadway network and therefore will have no impact to local traffic operations.

- **Changes in Travel Patterns**

To determine the impact of changes in travel patterns on traffic, earlier in the study CTPS identified the number of daily auto trip destinations to each of 29 high-congestion activity zones selected by each community in the Corridor. These projections showed the number of auto trips with destinations in the selected activity zone, and therefore represent approximately 50 percent of the total trips to and from those activity zones. Daily auto trip destinations for each alternative were compared to the future “No Build” auto trip destinations. The results provided a comparison of the impacts of the Urban Ring alternatives. However, it should be borne in mind that the selected activity zones are only a sample, and therefore represent a small portion of trip generators in the Corridor and the land use and traffic volumes have increased with the 2025 projections compared to the 2020 projections used in that analysis. Hence, the results are more meaningful when considered on a percentage change, rather than an absolute change, basis. The main conclusion from this analysis conducted early in the MIS is as follows:

- Overall, there is no significant difference between alternatives in the reduction of daily auto destinations to the selected activity zones.

In addition to the above, there are traffic impacts that cannot be specifically quantified. For example, it is worth noting that increased transit service could result in the reduction or elimination of private shuttle bus routes. While the elimination of a route would have no significant impact on traffic volumes, the elimination of conflicts at drop-off/pick-up locations between the shuttle bus and other traffic could result in some reduction in traffic congestion or improvement in traffic operations. Based on this early analysis, each of the three “Build” Alternatives was projected to decrease private bus ridership by approximately 20-30 percent.

4.2 Detailed Analysis of Ridership and Operating Statistics

As part of the Major Investment Study, the Central Transportation Planning Staff (CTPS) conducted ridership forecasting and generation of operating statistics for the MBTA system in years 2003, 2010, and 2025 with and without the Urban Ring. Inputs to the modeling consisted of the final alternatives as defined in Chapter 3. CTPS summarized the results of its forecasting and modeling in a series of tables that were presented and discussed within the Urban Ring Steering Committee and technical committees. The tables referenced below are contained in the separate CTPS Urban Ring Technical Report. This

section provides a summary overview of the information contained in those tables as it was presented in May 2001.

° **Systemwide Ridership Statistics – TSM (2003)**

In this and subsequent tables TSM refers to the Urban Ring Phase 1 bus routes in the year 2003 consisting of the 3 proposed Express Commuter (EC) bus routes and 11 Cross-Town (CT) bus routes. NB refers to the “No-Build” condition that would exist in the absence of these Urban Ring routes. The table shows the following impacts of the Urban Ring in Phase 1:

- Total Urban Ring ridership is 40,300 in year 2003
- It would relieve local bus crowding (-9,900) and central subway crowding (-38,550)
- It would increase Silver Line ridership by 11,050. This is likely due to several new Urban Ring Crosstown routes that would feed ridership to/from the Silver Line at interface points such as Dudley Square and the intersection of Melnea Cass and Washington Street.
- Diverts 3,700 auto trips to the transit system
- The increase in transit mode share is 0.04

° **Systemwide Ridership Statistics – TSM + BRT (2010)**

The Phase 2 Urban Ring service consists of 7 BRT routes plus the non-redundant Phase 1 EC and CT bus routes (aka TSM) that continue to operate in Phase 2. In the transition from Phase 1 to Phase 2 the EC1 route is superseded by the commuter rail to BRT connection, and five of the Phase 1 CT routes are superseded by the various Phase 2 BRT routes. The increased service frequency and quality of the Phase 2 BRT routes combined with the higher overall number of total trips in the system, results in a significant increase in ridership and positive systemwide impacts compared to Phase 1.

- Total Urban Ring ridership increases to 106,000 in year 2010. Growth is due to combination of improved service being more attractive and overall demographic growth over 7-year period. Relieves local bus crowding (-24,550) and central subway crowding (-90,500)
- Increases Silver Line ridership by 9,400 - which is less than with Urban Ring Phase 1.
- Diverts 13,150 auto trips to the transit system
- The increase in transit mode share is 0.09

° **Systemwide Ridership Statistics – TSM + BRT + Rail (2025)**

In Phase 3 the Urban Ring service consists of the EC/CT buses, six of the seven Phase 2 BRT routes, and an Urban Ring rail system all working together. The rail alignment alternatives are designated A (Kenmore) or B (BU). Alignment A has two technology options referred to as A1 (LRT Green Line compatible) or A2 (Heavy Rail/Rapid Transit Orange Line compatible). Alignment B can only use LRT due to grade crossings and tighter curves.

On a systemwide basis the impacts of A1, A2, and B are quite similar in the year 2025. Differences become more apparent when examining those impacts on individual components in the system.

- Total Urban Ring ridership ranges from 282,500 to 293,800 (within 5% of each other)
- Auto diversions to transit range from 37,900 to 39,000 (within 3% of each other)
- Increase in transit mode share ranges from 0.27 to 0.28 - either of which represents a substantial increase in transit mode share for a mature system.

Analysis of the impact on unlinked transit trips by sub-mode shows more variation, depending upon the mode:

1. *Commuter Rail*: Good Synergy – All of the alternatives would boost commuter rail ridership by nearly 18,000 per day based on comparison to Phase 3 No-Build. There is virtually no difference between Alternatives A1, A2, and B. These additional commuter rail riders will increase demand for commuter rail parking facilities.
2. *Heavy Rail and LRT (Referred to in table as Rapid Transit)*: Strong Diversions - All the alternatives would divert substantial ridership from the existing rapid transit lines thereby relieving central subway congestion. The Urban Ring LRT alternatives (A1 and B) would divert somewhat more ridership than the Urban Ring Orange Line alternative (A2). All three alternatives divert primarily from the Green Line, though Alternative A2 also would divert substantially from the existing Orange Line.
3. *Silver Line*: The slight net reduction in Silver Line ridership is very similar among each of the Urban Ring Alternatives. Similar to its impact on other radial transit lines, the Urban Ring will divert some trips from the Silver Line that would otherwise have transferred in the central subway to reach Corridor destinations north or south of the Silver Line.
4. *Local Buses*: Urban Ring results in a reduction of systemwide local bus ridership ranging from 40,000 (A2) to 50,000 (B) per day. Alternative B covers a larger geographic area north of the Charles River which likely accounts for its higher total diversions from local buses. Regardless of the alternative, ridership diverted to the Urban Ring service from local buses may reduce local bus crowding as well as present an opportunity to reexamine potentially redundant and underutilized local bus routes during environmental process to reduce systemwide operating costs without impacting accessibility.
5. *Urban Ring Service - BRT*: Alternative B has lower BRT ridership in Phase 3 than does Alternatives A1 and A2. This is largely due to the LRT route and station locations of Alternative B being close to the BRT3 route through Somerville and attracting some ridership away from it.
6. *Urban Ring Service - LRT*: The ridership is very strong from the two LRT routes that will operate overlapping service under both Alternatives A1 and B. A good portion of this ridership is due to the interline feature with the standard Green Line Extension that would provide a single seat ride between the Green Line Extension and the Urban Ring. The overlapping service provides 18 trains/hour in each direction between New Lechmere and Dudley Square (overlapping 5 and 10 minute peak headways of these two routes).
7. *Urban Ring Service – Heavy Rail*: The ridership is very strong from a single heavy rail route operating as a branch of the Orange Line from Wellington in Alternative A2. This single route would provide 15 trains/hour in each direction between Wellington and Dudley Square (single route with 4 minute peak headway).
8. *System-Wide Transfers*: There is a net increase in systemwide transfers in each of the alternatives. The location and cause for this increase in transfers is under review.

◦ **Commuter Rail and Rapid Transit Weekday Ridership**

1. *Commuter Rail* – The net increase in commuter rail ridership is similar regardless of the Phase 3 Urban Ring alternative.
2. *Green Line* – Alternatives A1 and B utilize Green Line LRT technology and interline with the Green Line Extension at New Lechmere. This facilitates a major diversion of Green Line riders from the central subway onto the Urban Ring, thereby relieving future pressure on Green Line capacity. This is primarily due to capacity improvements contained in the 2025 Regional Transportation Plan. Alternative A2 also relieves Green Line congestion, though to a slightly less extent.
3. *Red & Blue* – There is little difference between the alternatives regarding the impact on Red Line and Blue Line volumes. The diversions are not as significant as on the Green Line. They all would reduce Red Line congestion to a similar degree. Alternative A2 diverts somewhat more riders from the Blue Line than does the other alternatives.

4. *Orange Line* – Alternative A2 diverts the most ridership from the existing Orange Line because it would interline with the Orange Line between Wellington and Sullivan Square, and operate as a new branch of the Orange Line. Existing Orange Line riders from the north (Oak Grove) bound for destinations in Cambridge, for example, would no longer need to transfer to the Red Line in downtown Boston. Instead, with the Urban Ring they would travel directly from Wellington or Sullivan Square into Cambridge along the new Urban Ring branch of the Orange Line.

◦ **Daily Ridership on the Urban Ring Services**

1. *EC3* – It is recommend dropping this route completely (from all phases) based on poor ridership.
2. *CT2* – Will likely drop this route only from Phase 3 because the ridership is poor. Phase 1 ridership seems fine.
3. *CT3* – Ridership in 2003 is relatively low.
4. *CT4* – Ridership in 2003 is relatively low.
5. *CT7* – The difference in the CT totals by alternative are attributable to this route. The results seem to indicate that transit users will prefer a single seat bus ride between Roxbury and Kendall Square on the CT7 in Alternative B rather than transferring to/from the CT7 bus and the Urban Ring rail system at Dudley Square as would be the case in Alternatives A1 and A2.
6. *BRT1 and BRT2* – These BRT routes show strong ridership, particularly at the stations located at Logan Airport, the Blue Line, downtown Chelsea, Everett Avenue, Revere Beach Parkway, and Wellington.
7. *BRT3* – This route links Wellington with Kendall Square via Gilman Square and Union Square. The ridership is highest for this route when coupled with rail alternatives A1 or A2 whose stations are located further away from these locations.
8. *BRT4* – Ridership for this Turnpike/East Cambridge route is lower when coupled with the Cambridgeport rail alignment, likely due to the presence of the Cambridgeport rail station in Alternative B. This route would utilize exclusive bus ramps connecting East Cambridge with the Turnpike via a reconfigured Grand Junction Bridge.
9. *BRT5* – This route is essentially a BRT version of the CT2 route and is applicable only to Phase 2. It shows high ridership and will be superseded in Phase 3 by the Urban Ring rail route.
10. *BRT6* – This is the Melnea-Hampden-Uphams route. Good ridership overall which is similar for all alternatives, as would be expected given the routes and station locations are the same.
11. *BRT7* – Ridership for this route, which supersedes the CT3, seems low given the expected huge growth in jobs in this area. Sensitivity analysis of this route and station compared to an I-93/I-90 route to the Courthouse area may help to understand why.
12. *LRT1* – This is the Assembly Square to Dudley Square LRT route. Alternative B shows higher ridership than A1. Possible differences include the shifting of the Kendall Red Line interface westward to the mid-block connector in Alternative B, as well as the additional station stops associated with Alternative B.
13. *LRT2* – This is the overlapping route that interlines from the Green Line Extension. On this interlining route Alternative A1 has higher ridership than Alternative B. This is likely due to the parallel service of the Urban Ring and the Green Line extension in Somerville between Washington Street and New Lechmere in Alternative B, whereas in Alternative A1 the Green Line Extension would be the only LRT service in this portion of the corridor. LRT1 and LRT2 combined boardings are 203,850 for Alternative A1 and 215,300 for Alternative B.
14. *Heavy Rail (Referred to in Table as Rapid Transit)* – Interesting to note that the Urban Ring Orange Line in Alternative A2 is projected to have somewhat more boardings in 2025 than the balance of the Orange Line in 2025. In Alternative A2 the boardings from the single Urban Ring Orange line route would be 206,300.

◦ **Maximum Load Point Volumes on the Subway Lines (2025)**

The table shows that in the year 2025 without the Urban Ring the Green and Red Lines each would experience some degree of capacity problems in the AM peak period (3 hour period 6:00AM to 9:00AM). The Green Line problem would be in both directions, while the Red Line problem would be heading into Broadway from the south. Additionally, the Orange Line would be very close to capacity heading into North Station from the north. Under each of the Urban Ring alternatives the peak loads on these lines would be brought well within capacity. Alternatives A1 and B achieve the greatest reduction in Green Line demand. Alternative B is most effective at reducing Red Line demand. Finally, Alternative B is most effective at reducing demand on the existing Orange Line. As discussed in paragraph 4.1.4, demand on capacity is more pronounced during the busiest hour of the peak period. It is likely that the reductions on the Green, Red, and Orange Lines achieved by the Urban Ring would be sufficient to address peak hour capacity issues on these lines in 2025.

◦ **Results of the Air Quality Impact Analysis (Daily Reductions)**

The reductions are sizeable, and are similar across all the alternatives in Phase 3. The biggest difference is with VMT reduction where Alternative A2 provides the greatest impact. Air quality benefits of the Urban Ring are discussed within Chapter 5.

◦ **Daily Travel Time Savings (Relative to No-Build)**

Each alternative results in daily time-savings to travelers of approximately 50,000 hours in the year 2025. Most of the time savings is for existing transit riders who will spend less time waiting for the transit vehicle to arrive (out-of-vehicle time), and the more direct routing will also save time (in-vehicle time).

◦ **Urban Ring Services – Daily Station Boardings Year 2025**

For each station a daily figure is provided for each type of service (Bus, BRT, and Rail) as well as for the new commuter rail stations (CR) that would be implemented by the Urban Ring. The column identified as transfer boardings represent the portion of the total boardings whose mode of access to the Urban Ring service is a transfer from another MBTA service. Since the Urban Ring interfaces with every existing and planned MBTA transit line, all commuter rail lines, and approximately half the bus routes, it is not surprising that the majority of the ridership comes from transfers with these lines.

◦ **Daily Operating Statistics**

The diversions from radial transit and bus lines that would occur with the Urban Ring result in significant reductions in the number of passenger miles on those lines compared to the No-Build. The reduction in passenger demand on radial transit and bus lines achieved by the Urban Ring could result in reductions in operating and maintenance costs on those lines compared to the No-Build.

Table 4-1
Travel Time Savings of The Phase 3 Alternatives

Category	Total Travel Time Benefits (in hours)		
	Alternative A1 vs. No Build	Alternative A2 vs. No Build	Alternative B vs. No Build
Auto, Commercial trucks, etc.,	12,600	12,550	12,500
Transit: In Vehicle			
Existing Riders	14,596	15,429	15,061
New Riders	1,053	1,236	1,073
Transit: Out-of-Vehicle			
Existing Riders	19,304	20,251	19,919
New Riders	1,633	1,720	1,664
TOTAL	49,186	51,186	50,217

Source: CTPS May 2001

Note: Savings are in Year 2025 compared to the No-Build scenario

Table 4- 2

Travel Time Savings For Example Origin/Destination Pairs - Urban Ring Compared to No-Build by Phase

PHASE 2		No Bld 2010			2010			Travel Time Savings		
origin	destination	<u>before</u>			<u>after</u>					
		in-veh	out-veh	total	in-veh	out-veh	total	in-veh	out-veh	total
Assembly Sq	U Park/MIT	19.00	20.00	39.00	17.25	13.40	30.65	1.75	6.60	8.35
Dudley	Kendall	24.30	23.00	47.30	22.50	15.00	37.50	1.80	8.00	9.80
Alewife	Fenway	24.60	19.42	44.02	21.18	17.00	38.18	3.42	2.42	5.84
Lynn	Logan Airport	30.00	16.00	46.00	18.60	14.50	33.10	11.40	1.50	12.90
Uphams Corner	Boston Med Ctr.	14.00	15.00	29.00	9.50	8.10	17.60	4.50	6.90	11.40
Ruggles	Umass Campus	33.00	11.50	44.50	26.50	8.50	35.00	6.50	3.00	9.50
DT Chelsea	Logan Airport	18.50	19.00	37.50	11.39	6.00	17.39	7.11	13.00	20.11
PHASE 3		No Bld 2025			Alt A1 - 2025			Travel Time Savings		
origin	destination	<u>before</u>			<u>after</u>					
		in-veh	out-veh	total	in-veh	out-veh	total	in-veh	out-veh	total
Assembly Sq	U Park/MIT	19.10	20.00	39.10	11.08	9.50	20.58	8.02	10.50	18.52
Dudley	Kendall	25.30	23.00	48.30	13.00	7.20	20.20	12.30	15.80	28.10
Alewife	Fenway	25.60	17.00	42.60	18.70	11.50	30.20	6.90	5.50	12.40
Lynn	Logan	32.00	16.00	48.00	19.60	14.50	34.10	12.40	1.50	13.90
Uphams Corner	Boston Med Ctr.	15.00	15.00	30.00	9.91	8.00	17.91	5.09	7.00	12.09
Ruggles	UMass Campus	34.00	11.50	45.50	27.70	8.50	36.20	6.30	3.00	9.30
DT Chelsea	Logan Airport	18.50	19.00	37.50	11.40	6.00	17.40	7.10	13.00	20.10
PHASE 3		No Bld 2025			Alt B - 2025			Travel Time Savings		
origin	destination	<u>before</u>			<u>after</u>					
		in-veh	out-veh	total	in-veh	out-veh	total	in-veh	out-veh	total
Assembly Sq	U Park/MIT	19.10	20.00	39.10	12.70	9.50	21.80	6.40	10.90	17.30
Dudley	Kendall	25.30	23.00	48.30	13.30	7.20	20.50	12.00	15.80	27.80
Alewife	Fenway	25.60	17.00	42.60	20.85	11.40	32.25	4.75	5.60	10.35
Lynn	Logan	32.00	16.00	48.00	19.60	14.50	34.10	12.40	1.50	13.90
Uphams Corner	Boston Med Ctr	15.00	15.00	30.00	9.91	8.00	17.91	5.09	7.00	12.09
Ruggles	Umass Campus	34.00	11.50	45.50	27.70	8.50	36.20	6.30	3.00	9.30
DT Chelsea	Logan Airport	18.50	19.00	37.50	11.40	6.00	17.40	7.10	13.00	20.10

Source: CTPS June 2001. The times shown include walk access and wait time equal to ½ the peak period headway.

Notes: Numbers shown are in minutes and fractions of minutes for single one-way trip in AM peak period.

Time savings for Alternative A2 not shown would be the same or greater than those shown for Alternative A1.

Table 4-3
Daily Ridership on the Urban Ring Services

Route*	Route Description	TSM			BRT	Rail (Kenmore)		Rail (BU)
						A1	A2	B
		Phase 1	Phase 2	Phase 3	Phase 2	Phase 3	Phase 3	Phase 3
		2003 TSM	2010 TSM	2025 TSM	2010 TSM+BRT	2025 TSM+BRT+LRT	2025 TSM+BRT+HRT	2025 TSM+BRT+LRT
EC1	Woburn/Mishawum - University Park	3,550	4,100	4,350				
EC2	Lechmere - Riverside	1,600	1,950	2,150	1,600	1,700	1,800	1,650
EC3	Kenmore - Rt. 9 Natick	430		550	500	400	400	250
	EC Total	5,580	6,050	7,050	2,100	2,100	2,200	1,900
CT1	Central Square - Andrew	3,500	3,250	3,800	2,950	2,100	2,200	2,650
CT2	Sullivan Square - Longwood Med. Area	4,470	5,850	5,300		400	400	
CT3	Longwood Med Area/ Airport Blue Line Sta.	1,100	900	1,500				
CT4	Ruggles - UMass	1,120	1,000	1,200				
CT5	Logan Airport - Sullivan Square	6,360	8,400	10,200				
CT6	Bellingham/Chelsea Comm. Rail - Kendall	2,080	2,850	750	400	100	100	100
CT7	Kendall Square - Franklin Park Zoo	4,940	5,550	7,000	6,550	700	700	5,230
CT8	Sullivan Square - Longwood Med. Area	3,380	3,750	3,450				
CT9	Kenmore - Harvard Square	2,500	2,900	3,000	2,650	5,150	5,000	4,400
CT10	Kenmore - JFK/UMass	3,000	2,800	4,000	2,800	1,550	1,600	1,650
CT11	Longwood Med Area - Fields Corner	2,270	2,250	2,400	3,800	4,700	4,900	5,850
	CT Total	34,720	39,500	42,600	19,150	14,700	14,900	19,880
BRT1	Logan Airport - Kendall Square				34,300	31,500	31,300	29,970
BRT2	Logan Airport - Wellington				11,900	10,800	12,100	10,800
BRT3	Wellington - Kendall Square				8,850	7,100	10,000	5,450
BRT4	Riverside - Kendall Square				9,650	4,850	5,100	3,100
BRT5	New Lechmere - Longwood Med. Area				11,300			
BRT6	Longwood Med Area - UMass				4,850	5,000	4,900	4,800
BRT7	Longwood Med Area/Airport Blue Line Sta.				3,900	2,600	2,550	2,600
	BRT Total				84,750	61,850	65,950	56,720
LRT1	Assembly Square - Dudley Square					107,350		129,400
LRT2	Medford Hill Side - Dudley Square					96,500		85,900
HRT1	Wellington - Dudley Square						206,300	
	LRT/HRT Total					203,850	206,300	215,300
	TOTAL – ALL ROUTES	40,300	45,550	49,650	106,000	282,500	289,350	293,800

Route name denotation:

ec: Express Commuter Bus

EC: Crosstown Bus

BRT: Bus Rapid Transit

LRT: Light Rail Transit

HRT: Rapid Transit

Note: The Logan Airport and UMass locations are currently served by private shuttle operations. In Phase 1 the proposed CT3, CT4 and CT5 routes would serve these locations. Implementation of Phase 1 service in such locations will be need to address issues of vehicle purchase, operating subsidy, 13(c) indemnification, and indemnification of competition claims from current shuttle contractors. In Phase 2 the proposed BRT1, BRT2 and BRT6 routes would serve locations currently served by non-MBTA shuttle bus operators. Implementation of Phase 2 service in such locations will be need to address issues of vehicle purchase, operating subsidy, 13(c) indemnification, and indemnification of competition claims from current shuttle contractors to the extent that they have not already been resolved in Phase 1.

Source: CTPS

Table 4-4
Phase 3 Daily Boardings by Alternative and Geographic Segment

Segment ²	Alternative			
	TSM ³	Alt. A1	Alt. A2	Alt. B
Segment 1	NA	37,350	53,700	37,550
Segment 2	NA	128,550	116,800	130,400
Segment 3	NA	87,100	88,200	92,220
Segment 4	NA	12,350	13,200	11,500
Segment 5	NA	350	350	350
TOTAL BOARDINGS ⁴	49,650	265,700	272,250	272,020

Source: CTPS Daily Station Boardings Year 2025 aggregated by geographic segment.

² Refer to Figure 4-3 for map depicting geographic segments

³ The alternative consists of the Phase 1 TSM alternative in 2025.

⁴ Boardings shown for Alternatives A1, A2, and B are comprised of rail transit + BRT only, and do not include EC and CT bus route boardings for which geographic breakdown was not available. Addition of the EC and CT boardings would add 16,800 to Alternative A1; 17,100 to Alternative A2; and 21,780 to Alternative B total boardings.

Figure 4-1
Urban Ring Daily Ridership by Phase and Transit Mode

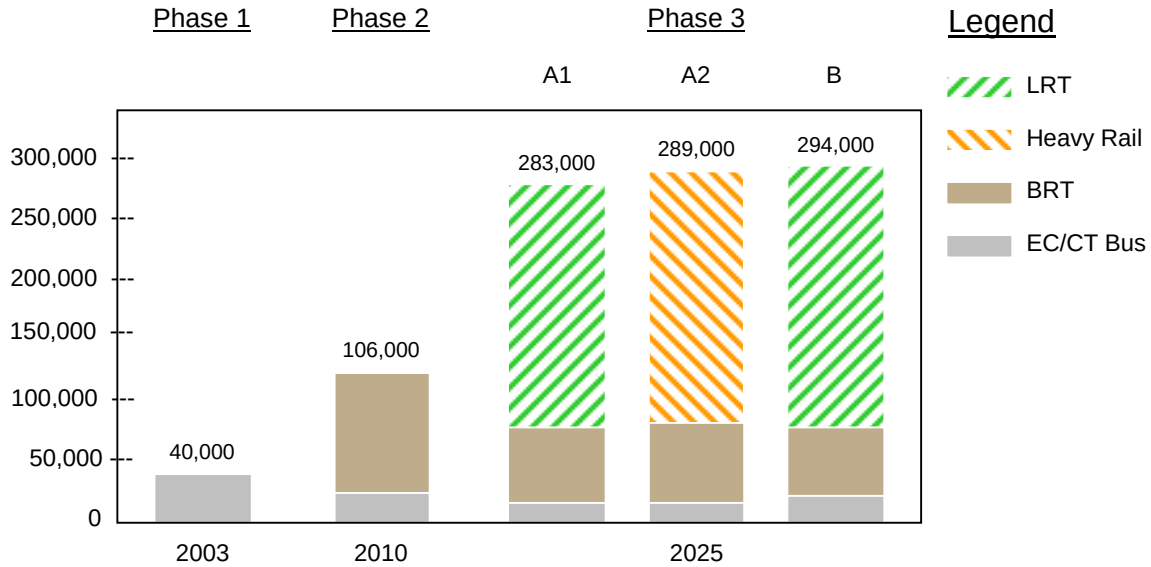
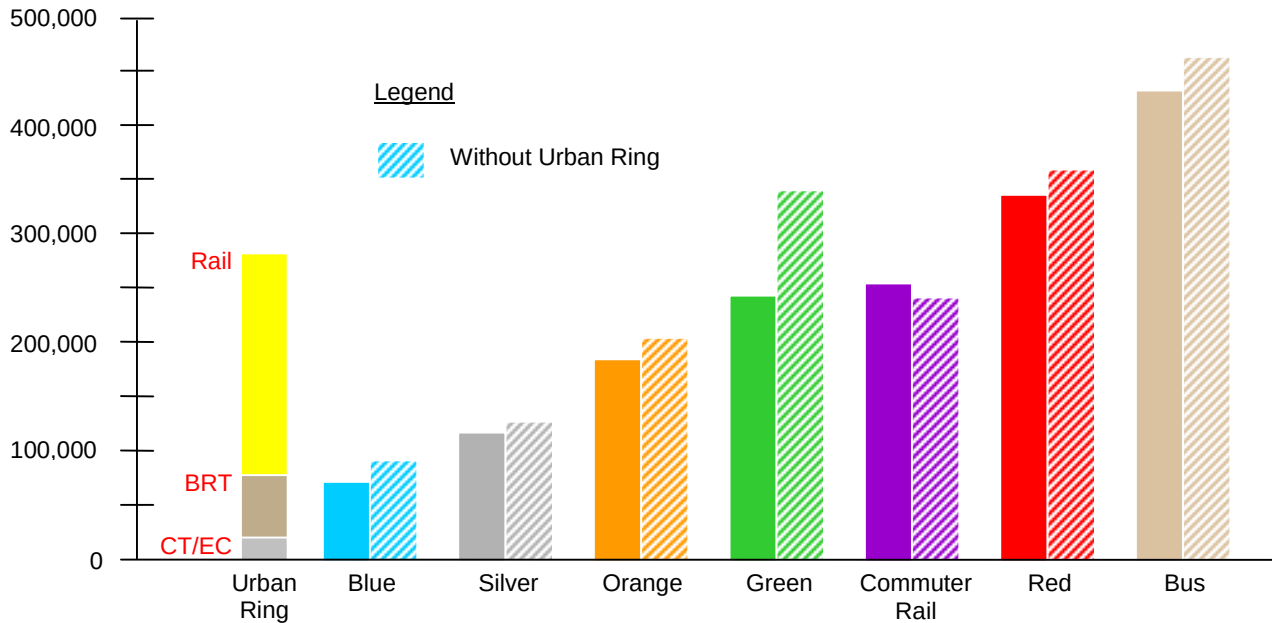
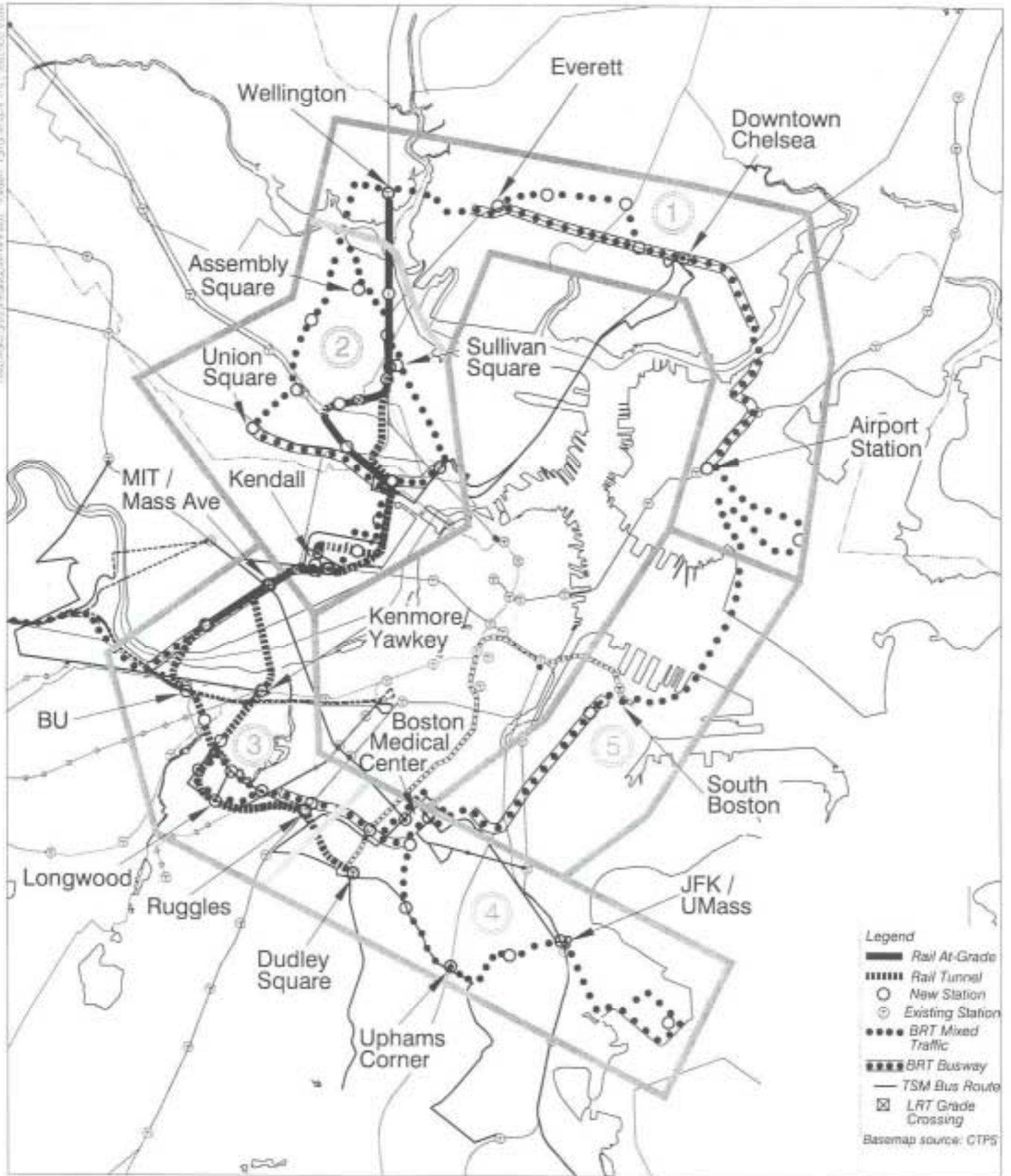


Figure 4-2
Daily Boardings by Service in the MBTA System with and without the Urban Ring Year 2025





Urban Ring Corridor

Composite Alignments and Segments

TRANSYT

APRIL 20, 2001



0 2250 4500 FT

Figure 4-3

FIGURE 4-4
Green Line Passenger Volumes Base Year 1995

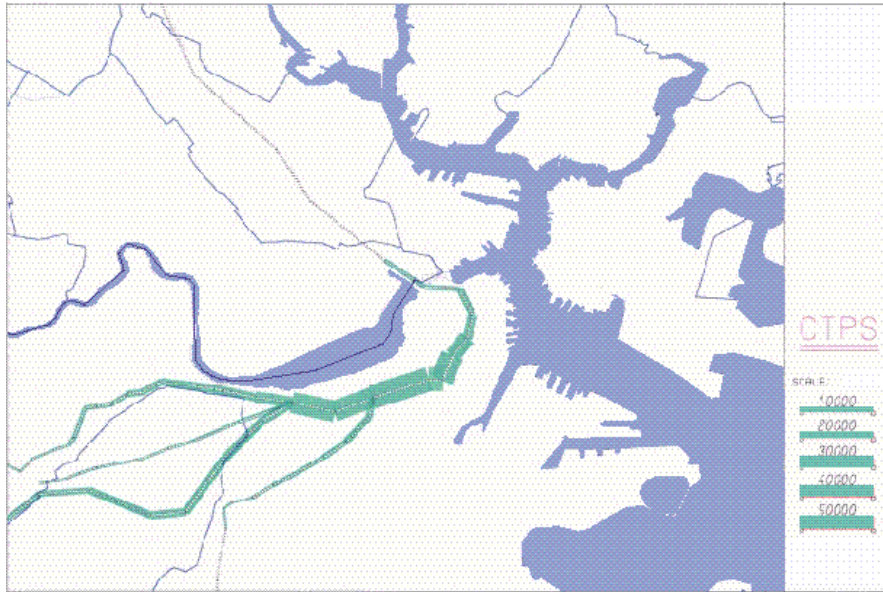


FIGURE 4-5
Green Line Passenger Volumes 2025 No-Build

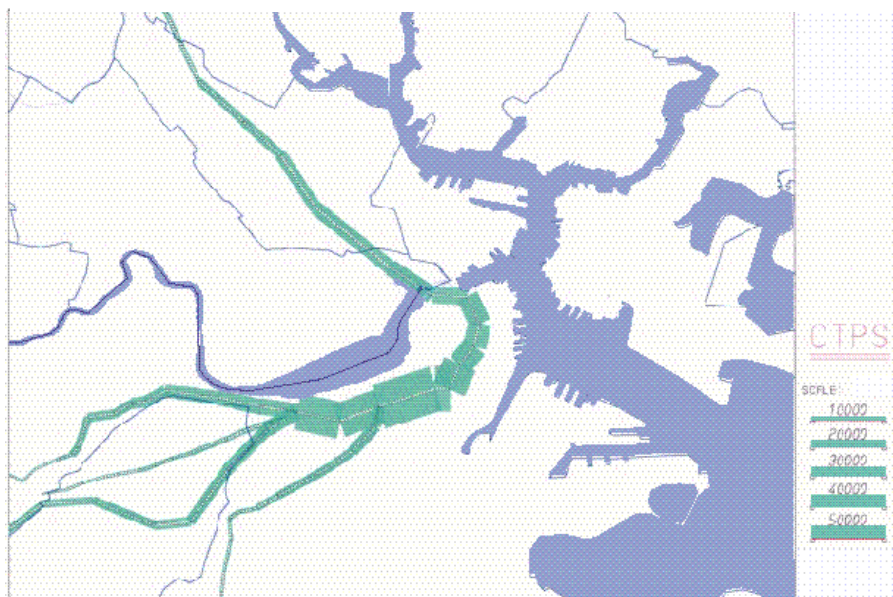


FIGURE 4-6
Alternative A1 – Urban Ring and Green Line Volumes 2025

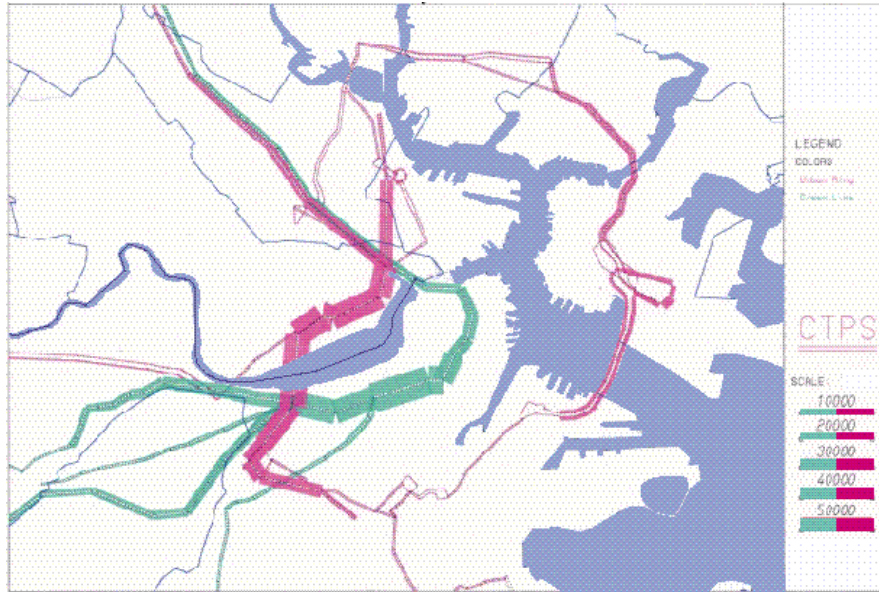


FIGURE 4-7
Alternative A2 –Urban Ring and Green Line Volumes 2025

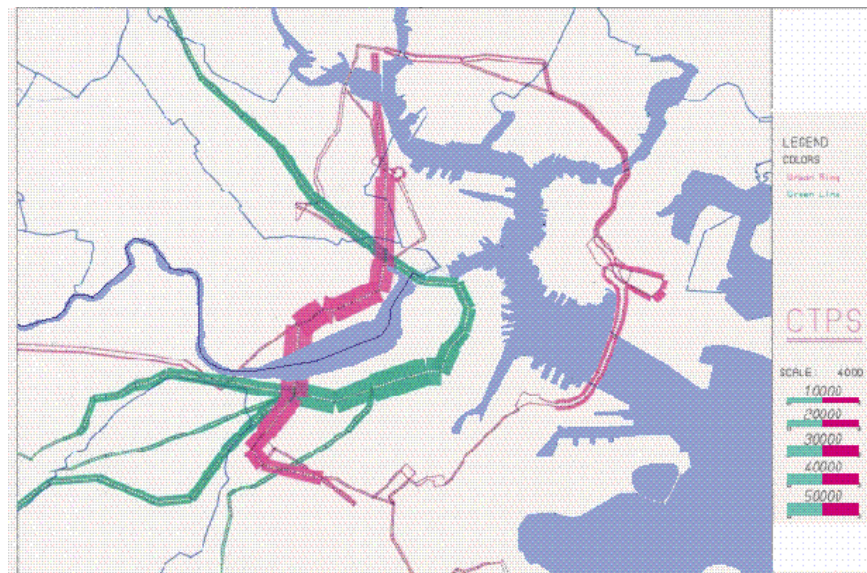
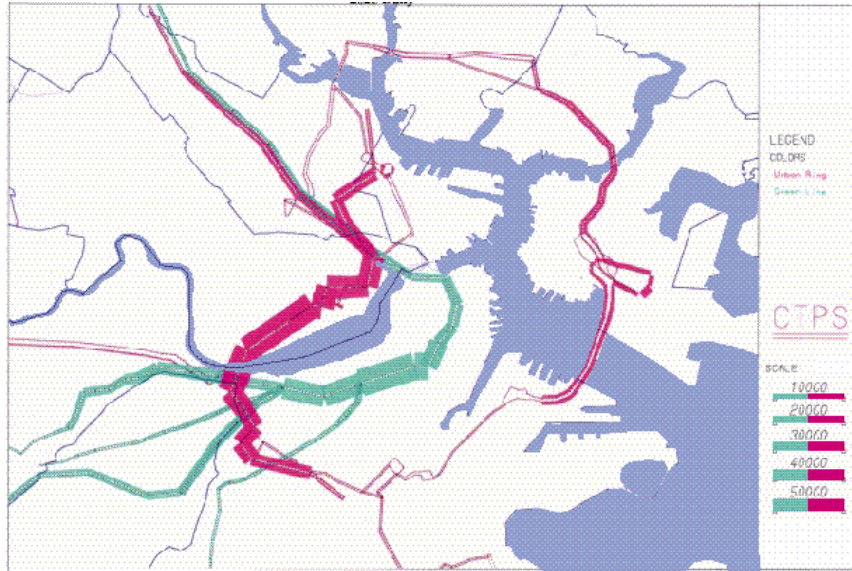


FIGURE 4-8
Alternative B – Urban Ring and Green Line Passenger Volumes 2025



Chapter 5

ENVIRONMENTAL CONSEQUENCES

5.0 ENVIRONMENTAL CONSEQUENCES

This chapter provides an assessment of the potential resource-related impacts expected to result from the Urban Ring alternatives proposed for further evaluation during the DEIS/DEIR for the project. A summary of the anticipated general levels of impacts of each of the Urban Ring final alternatives and phases upon these subject areas is presented in Table 5-11. Each of the final alternatives would be implemented over three phases as described in Chapter 3.

5.1 Methodologies/Potential Resource Impacts

A qualitative environmental screening analysis was conducted in each category for comparison purposes. Information concerning baseline environmental conditions within the corridor was developed for, and presented in, the environmental portion of the baseline technical memo prepared for the project.

This information was utilized to assess the potential impact of the alternatives relative to the following impact categories:

- Air Quality
- Noise and Vibration
- Electromagnetic Interference (EMI)
- Historic Resources
- Archaeological Resources
- Parkland/Open Space Resources
- Wetland Resources
- Hazardous Materials

5.2 Air Quality

5.2.1 Methodology

The air quality screening analysis was conducted for each Urban Ring phase and alternative. Impact levels were based on the following criteria:

- **Low** - Low level of impact to resource areas; impacts will require minimal amount of impact mitigation and/or additional environmental permitting.
- **Medium** – Moderate amount of impact to resource areas; impacts will require a moderate amount of impact mitigation and/or additional environmental permitting.
- **High** – Maximum amount of impacts to resource areas; impacts will require maximum amount of impact mitigation and/or additional environmental permitting.

5.2.2 Discussion of Individual Phases and Alternatives

The following sections describe the proposed Urban Ring phases and alternatives, and the potential impacts that implementation of each may have on air quality within the Corridor.

5.2.2.1 Phase 1, Transportation Systems Management (TSM) Alternative

The TSM services in Phase 1 would have the potential to negatively affect air quality in comparison to existing conditions due to an increase in bus emissions resulting from increased service if existing diesel buses were used. However, the MBTA is replacing its existing diesel buses with CNG powered buses with extremely low emissions. It is planned that the new bus routes in Phase 1 TSM Services will utilize CNG powered buses. Changes in traffic volumes caused by the additional bus traffic will be insignificant compared to existing traffic levels and should be more than offset by reductions in single occupancy vehicles (SOVs) on these same roadways. Therefore, this phase is rated as having a Low air quality impact.

5.2.2.2 Phase 2, TSM + Bus Rapid Transit (BRT) Alternative

Phase 2 is anticipated to have little if any adverse impacts to air quality. Portions of the Corridor are either existing or will be built by others, and are therefore not considered to create impacts as part of this project.

In comparison to existing conditions, the proposed Phase 2 services have little potential to negatively impact air quality because, as in Phase 1, the BRT vehicles planned for the Urban Ring service are CNG powered. The significantly higher transit mode share increase expected in Phase 2 should further reduce single occupancy vehicle (SOV) travel in the Corridor with positive air quality impacts. Therefore, this phase is rated as having a Low air quality impact.

5.2.2.3 Phase 3, Kenmore Alignment

- **Alternative A1: TSM + Bus Rapid Transit (BRT) + Light Rail Transit (LRT)**

The BRT segments are anticipated to have positive impacts on air quality. Any new construction may create temporary air quality impacts due to fugitive dust and pollutants from construction equipment exhaust. The LRT service is an all-tunnel alignment, except for a short at-grade section near Sullivan Square, and is the shortest rail route to connect with the existing MBTA lines.

Operational air quality impacts should be minimal due to the long tunnel section for the LRT system, which minimizes surface traffic interactions, and the use of CNG powered buses. Emissions will likely be reduced due to elimination of SOV VMT from the region's highways and local streets, thus resulting in less congestion. As a result, the air quality impacts of this alternative are anticipated to be low.

- **Alternative A2: TSM + Bus Rapid Transit (BRT) + Heavy Rail Transit**

The BRT segments are anticipated to have positive impacts to air quality. Any new construction may create temporary air quality impacts due to fugitive dust and pollutants from construction equipment exhaust. The Heavy Rail service is an all-tunnel alignment except for an at-grade section between Sullivan Square and Wellington Circle, and is the shortest rail route to connect with the existing MBTA lines.

Operational air quality impacts should be minimal due to the long tunnel section for the Heavy Rail system, which minimizes surface traffic interactions, and the use of CNG powered buses. Emissions will likely be reduced even further than with the BRT system due to elimination of more SOV VMT from the region's highways and local streets. As a result, the air quality impacts of this alternative are anticipated to be Low.

5.2.2.4 Phase 3, BU/Park Drive Alignment

◦ ***Alternative B – TSM + Bus Rapid Transit (BRT) + Light Rail Transit (LRT)***

The BRT segments are anticipated to have minimal adverse impacts to air quality. Any new construction may create temporary air quality impacts due to fugitive dust and pollutants from construction equipment exhaust. The LRT service is mostly an at-grade alignment.

Operational air quality impacts should be minimal due to the tunnel section for the LRT system, which minimizes surface traffic interactions, and the use of alternative-fuel buses. As a result, the air quality impacts of this alternative are anticipated to be Low.

5.2.3 Summary of Air Quality Impacts

The analysis of the Urban Ring Phases and Alternatives was performed to compare the anticipated air quality impacts of each phase and alternative of the project. Data utilized for this evaluation, contained in *Air Quality Analysis of the Urban Ring Alternatives*, May 24, 2001, Km Chang Environmental, Inc., were compiled by the Central Transportation Planning Staff (CTPS) using their projected net effects of each alternative upon the total vehicle miles traveled (VMT) and pollutant emissions in the region. In addition to the traditional criteria pollutants (VOC, CO, and NO_x), preliminary estimates of emissions of greenhouse gases (CO₂ and methane) are also provided, as required in the FTA Final Rules for Major Capital Investment Projects. These results are presented in Table 5-1. The pollutant emissions figures presented do not account for increased emissions due to increased bus operations. However, use of CNG powered buses for Urban Ring service would greatly reduce the emissions associated with bus operations.

Each phase of the project is projected to result in a decrease in regional VMT due to increased attractiveness of public transit versus travel in personal vehicles. Phase 1, which consists of only the TSM Phase, would result in the lowest VMT decrease (compared to the baseline case) of about 14,150 VMT per day. Phase 2, which includes the TSM plus the Bus Rapid Transit Services, would result in a decrease of 52,500 VMT per day. This total includes a contribution of 4,500 VMT per day reductions due to the TSM Phase alone.

In Phase 3, the Alternatives A1, A2, and B would each result in a decrease of over 350,000 VMT per day. Alternative A2 is projected to result in the greatest reduction in daily VMT (384,200) and Alternative A1 would result in the smallest daily VMT reduction (355,200).

Reductions in the emissions of each of the three primary air pollutants (volatile organic compounds, or VOCs; carbon monoxide, or CO; and nitrogen oxides, or NO_x) projected by the CTPS (see Table 5-1) would be expected to result from the implementation of any of the phases and build alternatives. These reductions in air pollutant emissions would be directly attributable to, and approximately proportional to, the reduction in VMT under each alternative. Since the Phase 1 TSM Services would result in the smallest decrease in VMT, it would also result in the smallest decreases in vehicle-generated pollutants. In Phase 2, the somewhat larger VMT reductions for the BRT Services would provide somewhat larger pollutant emissions reductions than in Phase 1.

Alternative A2 would result in the greatest reduction of VOCs and NO_x, and emissions of CO would be about the same as CO emissions from Alternative A1. Compared to Alternative A1, Alternative B would result in smaller reductions of VOCs and CO, and a slightly larger reduction in emissions of NO_x. The estimated reductions in greenhouse gas emissions are proportional to the reduction in VMT under each alternative.

5.3 Noise and Vibration

5.3.1 Methodology

A detailed noise and vibration assessment was performed to evaluate the potential impacts or environmental consequences of the Urban Ring Phase 2 BRT and Phase 3 rail alternatives at the existing and planned laboratories and other sensitive receptors in East Cambridge. This evaluation encompassed the area from Kendall Square to the Charles River crossing along the existing Grand Junction Rail Corridor. This corridor includes a number of MIT laboratories with vibration sensitive equipment. The alternatives under consideration along this section of the Urban Ring corridor include a dedicated BRT busway, an underground rapid transit or light rail system with two different alignments, and an at-grade light rail system. Noise and vibration impacts at other areas outside of East Cambridge in the Urban Ring study area are expected to be minimal.

Analysis was performed assuming a Grand Junction Corridor alignment. There is an option for a Vassar Street alignment in this area. The alignment decision will be made during the environmental process.

The noise and vibration assessment was performed in accordance with the Federal Transit Administration's (FTA) guidelines contained in their "Transit Noise and Vibration Impact Assessment" manual. The FTA's Transit Noise and Vibration Impact Assessment¹ guidance manual sets forth the basic concepts, methods and procedures for evaluating the extent and severity of noise impacts from transit projects. The FTA guidelines assess noise impacts based on the selected land-use's human sensitivity to noise. The FTA does not consider most commercial and industrial receptors, such as stores and manufacturing facilities, sensitive to transit-related noise. The FTA noise criteria are delineated into two categories: 'impact' and 'severe impact'. The 'impact' threshold defines areas where the changes in noise is noticeable but may not be sufficient to cause a strong, adverse community reaction. The 'severe impact' threshold defines the noise limits above which a significant percentage of the population would be highly annoyed by new noise.

The FTA vibration criteria are related to ground-borne vibration levels that are expected to result in human annoyance. The FTA's experience with community response to ground-borne vibration indicates that when there are only a few train events per day, then it would take higher vibration levels to evoke the same community response that would be expected from more frequent events. This is accounted for in the FTA criteria by distinguishing between projects with frequent and infrequent events, where the frequent-events category is defined as more than 70 events per day. The degree of sensitivity to vibration will depend on the specific equipment that will be affected by the vibration. The vibration limits for Category 1 buildings are based on acceptable vibration for moderately vibration-sensitive equipment such as optical microscopes and electron microscopes with vibration isolation systems. Defining limits for equipment that is even more sensitive requires a detailed review of the specific equipment involved. The FTA Category 1 criterion was used to assess vibration impacts at the MIT laboratories with vibration sensitive equipment.

A number of FTA Category 2 noise sensitive receptors (MIT student housing, residences, and hotels) have been identified along the proposed Urban Ring corridor between Kendall Square and the Charles River Crossing. Table 5-2 lists the Category 2 receptors located within 500 feet of the Grand Junction Corridor. In addition, MIT has identified a number of laboratories with vibration sensitive equipment at which vibration impacts were evaluated relative to the FTA Category 1 vibration criteria. Based on the information provided by MIT, Table 5-3 lists the buildings with vibration sensitive equipment.

A qualitative screening analysis was conducted for comparison purposes, and impact levels of Low, Medium, and High were based on the criteria described in Section 5.2.1.

5.3.2 Discussion of Individual Phases and Alternatives

The following sections contain descriptions of the Urban Ring phases and alternatives, and the potential impacts that implementation of each may have on noise and vibration within the Corridor.

5.3.2.1 Phase 1, Transportation Systems Management (TSM) Alternative

The TSM Alternative has the potential to negatively affect noise and vibration in comparison to existing conditions due to an increase in bus service. However, these impacts will be offset to a large degree because the new bus routes will be operating on roads that currently support bus traffic, and the elimination of some single occupant vehicles from the region's roadways. For the few locations where new bus routes will operate on roadways not currently supporting buses, noise and vibration impacts would be minimal. Changes in traffic volumes (and thus noise and vibration) caused by the new TSM Phase will be insignificant compared to existing traffic levels. Therefore, this phase is rated as having a Low noise and vibration impact.

5.3.2.2 Phase 2, TSM + Bus Rapid Transit (BRT) Alternative

The result of the noise assessment for Phase 2 is summarized in Table 5-4. The table shows the number of impacted receptors. For the Bus Rapid Transit in Phase 2, a total of nine Category 2 and one Category 3 receptors are expected to exceed the FTA impact criteria, and one Category 2 and one Category 3 receptors are expected to exceed the severe impact criteria. This phase is rated Medium for noise impacts.

The results of the vibration assessment are summarized for each Alternative in Table 5-5. For the BRT Phase 2, no vibration impacts are expected resulting in a Low impact.

5.3.2.3 Phase 3, Kenmore Alignment

- **Alternative A1: TSM + Bus Rapid Transit (BRT) + Light Rail Transit (LRT)**

No noise impacts to sensitive receptors are expected for the A1 Alternative (Low impact). Along the Grand Junction Alignment, a total of seven Category 1 buildings with vibration sensitive equipment are expected to exceed the FTA criteria if 65 Vdb in the East Cambridge area (Medium impact). Along the Vassar Street Alignment, which is further away from the laboratory facilities on Albany Street, the number of vibration impacts is expected to be reduced to two (Low impact).

- **Alternative A2: TSM + Bus Rapid Transit (BRT) + Heavy Rail Transit**

The noise and vibration impacts for Alternative A2 would be the same as for Alternative A1.

5.3.2.4 Phase 3, BU/Park Drive Alignment

- **Alternative B – TSM + Bus Rapid Transit (BRT) + Light Rail Transit (LRT)**

The at-grade LRT in East Cambridge will result in a High noise impact. A total of seven Category 2 and 19 Category 3 receptors are expected to exceed FTA impact criteria, and five Category 2 and 25 Category 3 receptors are expected to exceed the severe impact criteria. The severe impacts are due to the wheel squeal generated by the LRT vehicles traveling through the curves located in the Kendall Square area.

A total of eight Category 1 buildings with vibration sensitive equipment are expected to exceed the FTA criteria of 65 Vdb, resulting in a Medium impact.

5.3.3 Summary of Noise and Vibration Impacts

The preceding discussion assessed the potential noise and vibration impacts of the Urban Ring Phase 2 BRT and Phase 3 rail alternatives at the existing and planned laboratories and other sensitive receptors in East Cambridge. This evaluation encompassed the area from Kendall Square to the Charles River crossing

along the existing Grand Junction Rail Corridor. This corridor includes a number of MIT laboratories with vibration sensitive equipment. The alternatives under consideration along this section of the Urban Ring corridor include a dedicated BRT busway, an underground rapid transit or light rail system with two different alignments, and an at-grade light rail system. Noise and vibration impacts at other areas outside of East Cambridge in the Urban Ring study area are expected to be minimal. The noise and vibration assessment was performed in accordance with the Federal Transit Administration's (FTA) guidelines.

The underground rail alignments (A1 and A2 in Phase 3) will result in essentially no noise impact at sensitive receptor locations along the corridor. However, both the BRT busway (Phase 2) and the LRT at-grade (Alternative B in Phase 3) alternatives will result in noise impacts. The large number of severe noise impacts associated with the LRT at-grade alternative are due to wheel squeal generated by LRT passbys along the two tight curves in the Kendall Square area of the alignment. Noise impacts will also occur at the existing and proposed residential receptors along the corridor. Noise impacts at residential receptor areas can be mitigated by the construction of noise barriers.

For the BRT busway alternative (Phase 2), no vibration impacts are expected. However, for both the underground and at-grade rail alternatives (Alternatives A and B in Phase 3), vibration impacts are expected at a number of MIT laboratories (FTA Category 1 receptors) identified as having vibration sensitive equipment. For the two underground rail alignments (Alternative A1 and A2), the number of impacted buildings is significantly reduced by the Vassar Street alignment. The MIT laboratories along Albany Street are further away from this alignment and are not expected to be impacted by vibration from the train passbys.

Discussion with MIT Facilities Management staff indicates that low frequency vibrations are expected to pose the most significant problem due to potential impact on laboratory animals and the difficulty of mitigating low frequency vibration.

Additional detailed information relating to noise and vibration impacts can be found in *MBTA - Urban Ring Project, Noise and Vibration Assessment Report, Kendall Square to the Charles River Crossing*, KM Chng Environmental Inc., July, 6, 2001.

5.3.4 Mitigation of Noise and Vibration Impacts

The potential noise impacts of Phase 2 BRT and Phase 3 Alternative B would necessitate use of noise barriers and special window glazing to mitigate below impact threshold levels. Alternatively, in Phase 2 the BRT route could utilize the Vassar Street alignment that is already used by the CT2 bus rather than the new route along the Grand Junction right-of-way that currently experiences only intermittent noise from a few freight trains per day. The wheel squeal issue with Phase 3 Alternative B is more challenging because the right-of-way will not allow for a larger radius curve and the proximity of existing and planned buildings will make noise barriers impractical.

The potential vibration impacts are limited to Phase 3, and are highest with the at-grade LRT Alternative B which would exceed FTA Land Use Category 1 limits unless mitigated. Use of ballast mats is expected to be able to attenuate the vibration levels of Alternative B to within FTA Land Use Category 1 levels. However, MIT facilities department staff indicated that there could be facilities and equipment that would be impacted at levels more sensitive than the threshold defined by FTA. The tunnel alternatives A1 and A2 have somewhat lower potential for vibration impacts primarily due to the greater physical separation of the track in tunnels from the sensitive receptors.

The extent to which the Corridor contains receptors more sensitive to impact than the thresholds identified by FTA will need to be examined in greater detail during the environmental review process. Other areas of the Corridor with sensitive receptors such as the Longwood Medical Area will also need to be evaluated at that time.

Based on the qualitative evaluation no other areas of the corridor were identified to have significant potential problems with noise and vibration from the alternatives.

5.4 Electromagnetic Interference

5.4.1 Methodology

An assessment of electromagnetic interference (EMI) was performed to evaluate the potential impacts or environmental consequences of the Urban Ring Phase 3 rail alternatives at the existing and planned laboratories and other sensitive receptors in East Cambridge and the MIT area. For the Phase 3 rail alternatives, EMI may be produced by the use of electric propulsion and its associated electric supply lines. Potential EMI impacts are caused by electric currents and voltages utilized by the train; proximity of sensitive receptors to the rail line; pattern of current and voltage time variation; spatial configuration of the conductors supplying electric power; the quantity of rail traffic; and the degree of EMI isolation required by the sensitive receptors. Phase 1 (TSM) and Phase 2 (BRT) of the Urban Ring will not rely on electric motor propulsion, and therefore were not evaluated for EMI impacts. EMI impacts outside of East Cambridge in the Urban Ring study area are expected to be minimal.

The magnetic-field electric-propulsion currents are expected to have a frequency spectrum of 0 to 10 Hz, and to occur approximately every two minutes due to the intermittency of bi-directional rail traffic. It is expected that this component of the electric and magnetic fields (EMF) produced by the rail system is likely to be the most problematic in terms of interference with sensitive research measurements.

Many buildings currently abut the proposed Grand Junction and Vassar Street alignments under Alternatives A1, A2, and B. Most of these buildings are owned by MIT. Table 5-6 lists 11 sensitive receptors identified by MIT adjacent to the Grand Junction Right-of-Way and Vassar Street.

Calculations were done to predict the level of EMF that would be experienced by each building in the corridor under each Alternative for Phase 3.

For comparison purposes, the screening analysis was conducted qualitatively and impact levels of Low, Medium, and High were based on the criteria described in Section 5.2.1.

5.4.2 Discussion of Individual Phases and Alternatives

The following sections contain descriptions of the Urban Ring phases and alternatives, and the potential impacts that implementation of each may have on electromagnetic interference (EMI) within the Corridor.

5.4.2.1 Phase 1, Transportation Systems Management (TSM) Alternative

There would be no EMI impacts for the TSM phase, resulting in a Low impact.

5.4.2.2 Phase 2, TSM + Bus Rapid Transit (BRT)

There would be no EMI impacts from the BRT phase, resulting in a Low impact.

5.4.2.3 Phase 3, Kenmore Alignment

◦ Alternative A1: TSM + Bus Rapid Transit (BRT) + Light Rail Transit (LRT)

Table 5-7 summarizes EMI impacts for each of the Phase 3 Alternatives. Alternative A1 would have a slightly higher EMI impact than Alternative A2, but much lower than Alternative B for all distances evaluated, resulting in a Low to Medium impact. The EMI impact for Alternative A1 would range from 5.4 milligauss (mG) at 240 feet from track centerline to 143 mG at 15 feet.

- **Alternative A2: TSM + Bus Rapid Transit (BRT) + Heavy Rail Transit**

As shown in Table 5-7, Alternative A2 would have the lowest EMI impact as compared with the other two Phase 3 Alternatives, resulting in a Low impact. The EMI impact for Alternative A2 would range from 2.6 mG at 240 feet from track centerline to 57 mG at 15 feet.

5.4.2.4 Phase 3, BU/Park Drive Alignment

- **Alternative B – TSM + Bus Rapid Transit (BRT) + Light Rail Transit (LRT)**

Alternative B would have the highest EMI impact of the three Phase 3 Alternatives. The EMI impact for Alternative B would range from 6.1 mG at 240 feet from track centerline to 1,364 mG at 15 feet, resulting in a High impact.

5.4.3 Summary of Electromagnetic Interference

An assessment of electromagnetic interference (EMI) was performed to evaluate the potential impacts or environmental consequences of the Urban Ring Phase 3 rail alternatives at the existing and planned laboratories and other sensitive receptors in East Cambridge and the MIT area. For the Phase 3 rail alternatives, EMI may be produced by the use of electric propulsion and its associated electric supply lines. Potential EMI impacts are caused by electric currents and voltages utilized by the vehicles; proximity of sensitive receptors to the rail line; pattern of current and voltage time variation; spatial configuration of the conductors supplying electric power; the quantity of rail traffic; and the degree of EMI isolation required by the sensitive receptors. Phase 1 (TSM) and Phase 2 (BRT) of the Urban Ring will not rely on electric motor propulsion, and therefore were not evaluated for EMI impacts. EMI impacts outside of East Cambridge in the Urban Ring study area are expected to be minimal.

The magnetic-field excursions from electric-propulsion currents are expected to have a frequency spectrum of 0 to 10 Hz, and to occur approximately every two minutes due to the intermittency of bi-directional rail traffic. It is expected that this component of the electric and magnetic fields (EMF) produced by the rail system is likely to be the most problematic in terms of interference with sensitive research measurements. The highest magnetic field expected at grade, at the edge of the rail right of way (15 feet from the track centerline) is approximately 1,400 milliGauss (mG), and is due to the LRT at-grade in Alternative B. This value is approximately three times the earth's magnetic field, which is approximately 550 mG in Boston. However, the fields produced drop rapidly with distance. Thus, LRT or heavy-rail in tunnels will produce less EMI.

Table 5-8 compares the EMI impacts for each of the Phase 3 Alternatives. Alternative B would have the largest EMI impact among the three alternatives. Alternative B would have an impact over three times greater than Alternative A1 at a 50-foot depth and over seven times greater at an 80-foot depth. Compared with Alternative A2, it would have an EMI impact over eight times greater than Alternative A2 at a 50-foot depth and 17 times greater at an 80-foot depth. The conclusion is that light rail (Alternative B) would have the largest EMI impact and Alternative A2 (heavy rail) would have the lowest EMI impact on the sensitive receptors in East Cambridge.

Additional detailed information pertaining to EMI impacts can be found in the *Memorandum Estimation of Electromagnetic Interference (EMI) Generated by Urban-Ring Transportation Technologies*, Peter Valberg, Gradient Corporation, July 2001.

5.4.4 Mitigation of EMI Impacts

The potential EMI impacts of Phase 3 Alternative B would necessitate use of active and/or passive techniques to mitigate EMI below impact threshold levels. The physical separation provided by the tunnel

alternatives is effective at reducing the level of EMI experienced at the various facilities located along the Corridor. The strength of the EMI can also be reduced through the configuration of the supply and return lines for the electrical power system. The Heavy Rail alternative using third rail power places the power supply further from the sensitive facilities than does the LRT alternative that places the power supply on an overhead wire at the top of the tunnel or, in the case of the surface alignment, on a pole above the right-of-way.

Predicted EMI levels along the corridor with Alternative B are many times higher than the predicted levels associated with either of the tunnel alternatives A1 or A2 under either the Vassar Street or Grand Junction tunnel alignment. Moreover, the options for mitigation with the at-grade alignment are more limited because the alignment and power line cannot be directly shielded, as can the tunnel alignments.

Further analysis and discussion with MIT facilities staff will be necessary during the environmental process for Phase 3 to determine the extent of actual impacts and the cost of mitigation for each alternative. Other areas of the corridor with sensitive receptors such as the Longwood Medical Area and the Boston University laboratories will also need to be evaluated in greater detail at that time.

Based on the qualitative evaluation, no other areas of the corridor were identified to have any significant potential problems with EMI impacts from the alternatives.

5.5 Historic Resources

5.5.1 Methodology

The historic resources screening analysis was conducted for each of the final Urban Ring phases and alternatives, and is based upon the findings of the screening analysis conducted for the original eight Urban Ring alternatives presented in Chapter 11 of the MIS. This screening analysis was conducted qualitatively for comparison purposes, and impact levels of Low, Medium, and High were based on the criteria described in Section 5.2.1.

5.5.2 Discussion of Individual Phases and Alternatives

The following sections contain descriptions of the final Urban Ring phases and alternatives, and the potential impacts that implementation of these Urban Ring phases and alternatives may have on historic resources.

5.5.2.1 Phase 1, Transportation Systems Management (TSM) Phase

The TSM Phase has little potential for impacting historic resources. Although the new and modified bus routes will pass through or near a number of historic districts and individual properties, no direct impacts are anticipated due to the existence of urban traffic in these areas at the present time and the lack of proposed construction in this phase. Therefore, this phase is rated as having a Low potential for impacts to historic resources.

5.5.2.2 Phase 2, TSM + Bus Rapid Transit (BRT)

Construction of grade-separated rights-of-way along the BRT alignment will occur in Boston, Chelsea, Somerville, Cambridge, and Brookline. Mixed-traffic operations involving modifications of existing surface streets will occur in each municipality. New grade-separated rights-of-way have the higher potential to impact historic resources since they would generally involve more site disturbance than modifications of existing surface streets.

No historic districts were identified in the vicinity of the Phase 2 alignments in Chelsea, Everett, Medford, or Somerville. Four historic districts were identified in the vicinity of the alignments in Cambridge, three in Brookline, and five in Boston (Table 5-9). The Grand Junction Railroad Bridge, situated within the Charles

River Basin Historic District, would be modified to accommodate the BRT and a proposed pedestrian/bicycle lane. The potential impacts to historic districts associated with Phase 2 were rated as Medium to High.

5.5.2.3 Phase 3, Kenmore Alignment

- **Alternative A1: TSM + Bus Rapid Transit (BRT) + Light Rail Transit (LRT)**

Construction impacts on historic structures may result from the installation of additional infrastructure for new rights-of-way (ROWs) and from the construction of tunnels. The addition of new infrastructure such as poles, platforms, fencing, and subway entrances can have detrimental visual or intrusive effects on historic buildings and districts, potentially changing the exterior character of an entire historic area. In those locations where trains will be utilizing tunnels, construction impacts to historic resources may also be significant. Impacts from this type of construction have the potential result in both settlement and vibrational damage to structures.

No historic districts were identified in the vicinity of the Alternative A1 alignments in Chelsea, Everett, or Medford. One historic district was identified near the alignment in Somerville, five were identified in Cambridge, three in Brookline, and sixteen in Boston (Table 5-9). The potential impacts to historic districts associated with Alternative A1 were rated as Medium or High due mainly to the construction of tunnels.

- **Alternative A2: TSM + Bus Rapid Transit (BRT) + Heavy Rail Transit**

Construction impacts on historic structures that may result from construction of Alternative A2 are described under Alternative A1, above. No historic districts were identified in the vicinity of the Alternative A2 alignments in Chelsea, Everett, or Medford. One historic district was identified near the alignment in Somerville, five were identified in Cambridge, three in Brookline, and twelve in Boston (Table 5-9). The potential impacts to historic districts associated with Alternative A1 were rated as Medium to High due mainly to the construction of tunnels.

5.5.2.4 Phase 3, BU/Park Drive Alignment

- **Alternative B – TSM + Bus Rapid Transit (BRT) + Light Rail Transit (LRT)**

Construction impacts on historic structures that may result from construction of Alternative B are described under Alternative A1, above. No historic districts were identified in the vicinity of the Alternative A1 alignments in Chelsea, Everett, or Medford. One historic district was identified near the alignment in Somerville, two were identified in Cambridge, three in Brookline, and nine in Boston (Table 5-9). The potential impacts to historic districts associated with Alternative A1 were rated as Medium to High due mainly to the construction of tunnels.

5.5.3 Summary of Historic Impacts

The Urban Ring phases and alternatives each have the potential to adversely impact historic resources in the vicinity of the alignments. Impacts to historic resources may result from construction of the alignment or operation of buses and trains. Construction impacts may result from the installation of additional infrastructure for new rights-of-way and from the construction of tunnels. The addition of new infrastructure such as poles, platforms, fencing, and subway entrances can have detrimental visual or intrusive effects on historic buildings and districts, potentially changing the exterior character of an entire historic area. In those locations where trains will be utilizing tunnels, construction impacts to historic resources may also be significant. Impacts from this type of construction have the potential to result in both settlement and vibrational damage to structures. Operational impacts may include incompatibility with certain historic of buildings, architectural assemblages, and settings, as well as impacts caused by noise and vibration due to the operation of buses and trains.

Phase 1 will not result in impacts to historic resources since it involves only new or modified bus routes over existing infrastructure. Phase 2 and each alternative of Phase 3 have the potential to impact historic resources, due both to construction and operation of the transit systems. In general, Phase 3 may be expected to result in the greatest potential for impacts to historic resources due to the construction of tunnels, which could cause damage to structures through vibration and settlement.

The potential impacts to historic resources will require an intensive assessment during the DEIR/DEIS phase of the Urban Ring Project in order to more precisely define each historical resource area located in the vicinity of the alignment, and to determine potential impacts and appropriate mitigation of the impacts.

5.6 Archaeological Resources

5.6.1 Methodology

The archaeological resources screening analysis was conducted for each of the final Urban Ring phases and alternatives. This screening analysis was conducted qualitatively for comparison purposes, and impact levels of Low, Medium, and High were based on the criteria described in Section 5.2.1.

5.6.2 Discussion of Individual Phases and Alternatives

The following sections contain descriptions of the final Urban Ring phases and alternatives, and the potential impacts that implementation of these phases and alternatives may have on archaeological resources.

5.6.2.1 Phase 1, Transportation Systems Management (TSM) Phase

The TSM Phase will not impact archaeological resources due to the lack of proposed construction in this phase. No excavation that could have the potential to affect archaeological sites will occur. Therefore, this phase is rated as having a low potential for impacts to archaeological resources.

5.6.2.2 Phase 2, TSM + Bus Rapid Transit (BRT)

Under Phase 2, alteration of archeological resources may occur due to construction of new, exclusive at-grade lanes within new alignments. However, it is unlikely that undisturbed archaeological sites will be encountered within the project corridor due to intensive land development within the area. Therefore, this phase was determined to have a Low potential to impact archaeological resources.

5.6.2.3 Phase 3, Kenmore Alignment

- **Alternative A1: TSM + Bus Rapid Transit (BRT) + Light Rail Transit (LRT)**

Implementation of Alternative A1 may result in the alteration of archeological resources due to construction of exclusive at-grade lanes within new alignments, and excavation associated with tunnel construction in Somerville, Cambridge, and Boston. Undisturbed archaeological sites are unlikely to be encountered within the project corridor due to intensive land development, however, the potential for such impacts are higher in Phase 3 due to the excavation required for tunnel construction. Therefore, Alternative A1 was determined to have a Medium potential to impact archaeological resources.

- **Alternative A2: TSM + Bus Rapid Transit (BRT) + Heavy Rail Transit**

Construction impacts on archaeological resources may result from construction of exclusive at-grade lanes within new alignments, and excavation associated with tunnel construction in Somerville, Cambridge, and Boston. Undisturbed archaeological sites are unlikely to be encountered within the project corridor due to intensive land development, however, the potential for such impacts are higher in Phase 3 due to the

excavation required for tunnel construction. Therefore, Alternative A2 was determined to have a Medium potential to impact archaeological resources.

5.6.2.4 Phase 3, BU/Park Drive Alignment

◦ **Alternative B – TSM + Bus Rapid Transit (BRT) + Light Rail Transit (LRT)**

Alternative B has the potential to result in impacts to archaeological resources due to construction of exclusive at-grade lanes within new alignments, and excavation associated with tunnel construction in Somerville, Cambridge, Brookline, and Boston. Undisturbed archaeological sites are unlikely to be encountered within the project corridor due to intensive land development, however, the potential for such impacts are higher in Phase 3 due to the excavation required for tunnel construction. Therefore, Alternative B was determined to have a Medium potential to impact archaeological resources.

5.6.3 Summary of Archaeological Impacts

Implementation of Phase 1 will not result in impacts to archaeological resources, since it involves only new or modified bus routes over existing infrastructure. Phase 2 and each of the alternatives under Phase 3, however, have the potential to impact archaeological resources through direct alteration of archaeological sites due to new construction. Each of the alternatives under Phase 3 has a greater potential to alter archaeological sites than Phase 2 due to the greater amount of excavation required for tunnel construction. In order to determine whether or not a specific alternative route will impact archaeological sites, an intensive locational survey will need to be performed during the DEIR/DEIS phase of the Urban Ring Project to locate such sites, assess potential impacts, and determine appropriate mitigation.

5.7 Parkland/Open Space Resources

5.7.1 Methodology

The parkland/open space resources screening analysis was conducted for each of the final Urban Ring phases and alternatives. This screening analysis was conducted qualitatively for comparison purposes, and impact levels of Low, Medium, and High were based on the criteria described in Section 5.2.1.

5.7.2 Discussion of Individual Phases and Alternatives

The following sections contain descriptions of the final Urban Ring phases and alternatives, and the potential impacts that implementation of these phases and alternatives may have on parkland and open space resources.

5.7.2.1 Phase 1, Transportation Systems Management (TSM) Phase

The TSM Phase has little potential for negatively impacting parkland and open space resources due to the existence of urban traffic in these areas at the present time and the lack of proposed construction in this phase. A small positive effect of this phase may occur due to the potential for improved public access to parklands in the vicinity of the new and modified bus routes. Therefore, this phase is rated as having a Low potential for negative impacts to parkland and open space resources.

5.7.2.2 Phase 2, TSM + Bus Rapid Transit (BRT)

Parkland impacts under Phase 2 may result from direct alteration of parklands for busway construction. Indirect parkland impacts may result from high bus volume operation on surface streets. Higher volumes could negatively impact visual access to the parklands and landscaped boulevards, and may also further separate residents from the parks, possibly worsening perceptions of poor access. However, a positive effect may occur due to the potential for improved access to some parklands for more distant residents.

Direct alteration of existing parkland under this phase may occur in Cambridge and Brookline, within MDC parkland on both sides of the Charles River in the vicinity of the Grand Junction Railroad Bridge. Although the corridor in this area presently consists of railroad, wider approaches to the Bridge will be required to accommodate one lane for rail service, two BRT lanes, and one combined bicycle/pedestrian lane. Direct impacts to green space may also occur along Melnea Cass Boulevard in Boston. Therefore, this and any other parkland impacts will need to be assessed in detail during the EIR/EIS preparation for Phase 2, and parkland impacts for this phase have been determined to be High.

5.7.2.3 Phase 3, Kenmore Alignment

- **Alternative A1: TSM + Bus Rapid Transit (BRT) + Light Rail Transit (LRT)**

No direct impacts to public parkland are anticipated to result from this alternative, since most of the LRT corridor will be in tunnel. Small parkland impacts could occur where underground stations and above-ground station entrances are constructed, and these potential impacts will need to be considered during the EIR/EIS preparation for Phase 3. Parkland impacts for this alternative have been determined to be Low.

- **Alternative A2: TSM + Bus Rapid Transit (BRT) + Heavy Rail Transit**

Direct impacts to public parkland may occur under this alternative in the vicinity of the Wellington Bridge crossing of the Mystic River, on Route 28 in Somerville and Medford, where widening of the existing approaches to the Bridge may be needed to accommodate the Rapid Transit Line. The remainder of the Rapid Transit Line will be located within tunnel, and will therefore have no parkland impacts, with the possible exception of small impacts that could occur where underground stations and above-ground station entrances are constructed. These parkland impacts will need to be considered during the EIR/EIS preparation for Phase 3. Parkland impacts for this alternative have been determined to be Medium.

5.7.2.4 Phase 3, BU/Park Drive Alignment

- **Alternative B – TSM + Bus Rapid Transit (BRT) + Light Rail Transit (LRT)**

This alternative incorporates more extensive at-grade rail segments than either Alternatives A1 or A2, and extends further west along the Charles River to a tunnel crossing near the B.U. Bridge. The surface segment will not result in direct impacts to parkland. The sole potential impacts may result from construction of underground stations and associated above-ground station entrances, which will need to be considered during the EIR/EIS preparation for Phase 3. Parkland impacts for this alternative have been determined to be Low.

5.7.3 Summary of Parkland/Open Space Impacts

Implementation of Phase 1 will not result in adverse impacts to parklands, since it involves only new or modified bus routes over existing infrastructure. Phase 2 will likely result in direct alteration of MDC-owned public parkland in Cambridge and Brookline for the enlargement of approaches to the existing Grand Junction Railroad Bridge over the Charles River. Each of the alternatives under Phase 3 may require alteration of parkland for the construction of underground stations and associated above-ground station entrances. Alternative A2 may also require direct impacts to public parkland in the vicinity of the Wellington Bridge crossing of the Mystic River, on Route 28 in Somerville and Medford, where widening of the existing approaches to the Bridge may be needed to accommodate the Rapid Transit Line. These parkland impacts will need to be assessed, and appropriate mitigation considered, during the DEIR/DEIS phase of the Urban Ring Project.

5.8 Wetland Resources

5.8.1 Methodology

The wetland resources screening analysis was conducted for each of the final Urban Ring phases and alternatives based upon existing information (National Wetland Inventory, U.S. Fish & Wildlife Service) and data available from prior studies. This screening analysis was conducted qualitatively for comparison purposes, and impact levels of Low, Medium, and High were based on the criteria described in Section 5.2.1.

5.8.2 Discussion of Individual Phases and Alternatives

The following sections contain descriptions of the final Urban Ring phases and alternatives, and the potential impacts that implementation of each of these phases and alternatives may have on wetland resources.

5.8.2.1 Phase 1, Transportation Systems Management (TSM) Phase

The TSM Phase will not cause direct impacts to wetland resources since it involves no new construction. Indirect impacts to wetland resources in the vicinity of the new and modified bus routes, such as noise or air pollution, will be negligible due to the minimal change in urban traffic in these areas. Therefore, this phase is rated as having a Low potential for impacts to wetlands.

5.8.2.2 Phase 2, TSM + Bus Rapid Transit (BRT)

Phase 2 is anticipated to have direct impacts to wetland resources in Chelsea in the vicinity of the junction of the proposed Urban Ring route and the existing Newburyport Commuter Railroad, approximately 500 feet inland from the Chelsea River. The exclusive at-grade bus route ROW passes a small emergent wetland identified as a palustrine (non-tidal) wetland which is seasonally saturated. Widening of the existing railroad bed in this area to accommodate the BRT operating over the busway may require direct alteration of this wetland, which would require permitting under the Massachusetts Wetlands Protection Act, and possibly under Sections 401 and 404 of the Federal Clean Water Act. Direct wetland alteration may also occur under this phase to extend the existing Grand Junction Railroad Bridge piers in the Charles River to construct a wider deck to accommodate one lane for rail service, two BRT lanes, and one combined bicycle/pedestrian lane. Riverbank retaining wall work to provide stronger bank support may also be necessary in this area. This work will involve the permitting referenced above, as well as permitting under Section 10 of the Rivers and Harbors Act of 1899, and permitting or licensing under M.G.L. Chapter 91.

Busway construction adjacent to Chelsea Creek and the Charles River may also be determined to involve work within the Riverfront Area, a 25-foot-wide zone adjacent to rivers, and the 100-foot buffer zone to wetland resources, within which project impacts may require permitting under the Massachusetts Wetlands Protection Act. Also, surface access for underground stations may be constructed within the 100-foot buffer zone in the vicinity of the Muddy River in Boston, which would require an Order of Conditions from the Boston Conservation Commission under the Massachusetts Wetlands Protection Act.

These wetland impacts will need to be assessed, and appropriate mitigation considered, during the DEIR/DEIS phase of the Urban Ring Project. Due to the anticipated direct wetland impacts, this phase was determined to have a High potential for wetland impacts. Indirect wetland impacts may also result where project construction may occur within the 100-foot buffer zone along the banks of Chelsea Creek and the Charles River.

5.8.2.3 Phase 3, Kenmore Alignment

- **Alternative A1: TSM + Bus Rapid Transit (BRT) + Light Rail Transit (LRT)**

This alternative is not anticipated to result in any direct impacts to wetland resources, since the majority of the rail corridor will be located in tunnel. Surface access for underground stations may be constructed within the 100-foot buffer zone to wetland resources in the vicinity of the Muddy River in Boston, which would require an Order of Conditions from the Boston Conservation Commission under the Massachusetts Wetlands Protection Act. Also, the railroad tunnel beneath the Charles River may require permitting under Section 404 of the federal Clean Water Act.

The potential for wetland impacts will need to be assessed, and appropriate mitigation considered, during the DEIR/DEIS phase of the Urban Ring Project. The level of wetland impacts under this alternative has been rated as Medium.

- **Alternative A2: TSM + Bus Rapid Transit (BRT) + Heavy Rail Transit**

This alternative is not anticipated to result in any direct impacts to wetland resources, since the majority of the rail corridor will be located in tunnel. Surface access for underground stations may be constructed within the 100-foot buffer zone to wetland resources in the vicinity of the Muddy River in Boston, which would require an Order of Conditions from the Boston Conservation Commission under the Massachusetts Wetlands Protection Act. The construction associated with the railroad approaches to the Wellington Bridge over the Mystic River in Medford and Somerville may also require review by the Conservation Commissions of those communities. Also, the railroad tunnel beneath the Charles River may require permitting under Section 404 of the federal Clean Water Act.

The potential for wetland impacts will need to be assessed, and appropriate mitigation considered, during the DEIR/DEIS phase of the Urban Ring Project. The level of wetland impacts under this alternative has been rated as Medium.

5.8.2.4 Phase 3, BU/Park Drive Alignment

- **Alternative B – TSM + Bus Rapid Transit (BRT) + Light Rail Transit (LRT)**

This alternative is not anticipated to result in any direct impacts to wetland resources, since the majority of the rail corridor will be located in tunnel. Construction of the railroad tunnel beneath the Charles River, however, may require permitting under Section 404 of the federal Clean Water Act.

The potential for wetland impacts will need to be assessed, and appropriate mitigation considered, during the DEIR/DEIS phase of the Urban Ring Project. The level of wetland impacts under this alternative has been rated as Medium.

5.8.3 Summary of Wetland Resource Impacts

Implementation of Phase 1 will not result in wetland impacts, since it involves only new or modified bus routes over existing infrastructure. Phase 2 will likely result in direct impacts to wetlands in Chelsea and at the Grand Junction Railroad Bridge over the Charles River in Cambridge and Brookline, due to the need to enlarge bridge piers to accommodate the busway and a bicycle/pedestrian lane. Alternatives A1 and A2 under Phase 3 may require alteration of wetlands for the construction of underground stations and associated above-ground station entrances. Alternative B is not anticipated to require any direct wetland impacts. However, each of the Phase 3 alternatives may require permitting under Section 404 of the federal Clean Water Act for construction of the railroad tunnel beneath the Charles River. These wetland impacts will need to be assessed, and appropriate mitigation considered, during the DEIR/DEIS phase of the Urban Ring Project.

5.9 Hazardous Materials

5.9.1 Methodology

The hazardous materials screening analysis was conducted for each of the final Urban Ring phases and alternatives. This screening analysis was conducted qualitatively for comparison purposes, and impact levels of Low, Medium, and High were based on the criteria described in Section 5.2.1. For the purposes of this assessment, sites within 500 feet of the route were considered the most likely to have a potential impact on the alternative. Because many of the sites are presumably undergoing review and resolution per the Massachusetts Contingency Plan, some will likely be cleaned up prior to project implementation, some new sites may be identified, and others may result in specific project-related actions.

5.9.2 Discussion of Individual Phases and Alternatives

The following sections contain descriptions of the final Urban Ring phases and alternatives, and the potential impacts that implementation of these phases and alternatives may have on hazardous materials sites.

5.9.2.1 Phase 1 Transportation Systems Management (TSM)

The TSM Phase has will not impact or be affected by hazardous waste sites due to the lack of proposed construction in this phase. No excavation that could have the potential to affect hazardous waste sites will occur. Therefore, this phase is rated as having a Low potential for impacts to hazardous waste sites.

5.9.2.2 Phase 2, TSM + Bus Rapid Transit (BRT)

The Phase 2 elements most likely to be affected by hazardous waste sites are the construction of grade-separated rights-of-way, new stations, and other facilities, all of which will involve some level of excavation. Approximately 110 known hazardous waste sites exist in the vicinity of these elements of Phase 2. Table 5-10 presents a breakdown of the number of hazardous waste sites for each Urban Ring phase and alternative by community.

5.9.2.3 Phase 3, Kenmore Alignment

- **Alternative A1: TSM + Bus Rapid Transit (BRT) + Light Rail Transit (LRT)**

Phase 3 in general will likely be affected by site contamination to a greater extent than Phase 2 due to the greater amount of excavation required for tunnel construction. As with Phase 2, Phase 3 will also involve construction of new stations and other facilities, which will involve some level of excavation.

Approximately 49 known hazardous waste sites exist in the vicinity of the Phase 3, Alternative A1 corridor (Table 5-10).

- **Alternative A2: TSM + Bus Rapid Transit (BRT) + Rapid Transit Line (RTL)**

Alternative A2 follows a similar corridor to Alternative A1, with the exception of an extension of at-grade railroad northward from the Assembly Square area of Somerville to Wellington Station in Medford. This extension passes close to 4 known hazardous waste release sites in Somerville, which brings the total number of such sites for the entire Alternative A2 corridor to 53 (Table 5-10).

5.9.2.4 Phase 3, BU/Park Drive Alignment

- **Alternative B – TSM + Bus Rapid Transit (BRT) + Light Rail Transit (LRT)**

Alternative B follows a different route than Alternatives A1 and A2 along most of the corridor between Longwood Station in Boston northward through Brookline, Cambridge, and Somerville to Sullivan Square in Charlestown. Despite the different route, however, Alternative B passes near a similar number of hazardous waste sites (49) as Alternatives A1 and A2 (Table 5-10).

5.9.3 Summary of Hazardous Materials

Phase 1, involving only new and modified bus routes, will not require construction that could be affected by sites contaminated with hazardous wastes. Phases 2 and 3, which will involve excavation for the construction of dedicated busways, surface railroads, railroad tunnels, and associated stations and maintenance facilities, will likely be affected by the presence of contaminated soils and groundwater in the vicinity of hazardous waste sites. In general, Alternatives A1 and A2 may be expected to have a higher likelihood of being affected by site contamination due to the greater amount of excavation required for longer lengths of tunnel involved than would occur under Alternative B.

Viewed from another perspective, alternatives having greater potential for encountering contaminated sites would offer the greater opportunity for identifying and remediating existing site contamination, thereby benefiting the surrounding environment to a greater extent. Environmental issues associated with the remediation of hazardous materials release sites will include the need for health and safety plans associated with hazardous material exposure and handling for on-site workers and an increase in construction costs associated with the removal and disposal of this material.

Table 5-10 depicts the number of known hazardous material release sites located within 500 feet of each proposed Urban Ring phase and alternative, presented by community. Although each of the three Phase 3 alternatives will involve a greater amount of excavation due to tunnel construction, Phase 2 has a greater number of known hazardous material release sites located along its corridor (110). Each of the Phase 3 alternatives has a similar number of hazardous waste sites in the vicinity of its route (49 to 53).

Phase 2 and each of the Phase 3 alternatives were assigned a similar rating of High for the likelihood of being affected by hazardous waste release sites. This was due to the greater number of such sites along the Phase 2 corridor than the Phase 3 alternatives being balanced by the greater amount of excavation under Phase 3 for tunnel construction. Because of the great variability among release sites in terms of type of material(s) released, the magnitude of the release, and the groundwater and geological conditions in the vicinity of the release, a closer evaluation of specific hazardous release sites will need to be performed during the DEIS/DEIR phase of the Urban Ring project.

5.10 Summary Table

Table 5-11 provides a qualitative summary of the estimated impact levels associated with construction and implementation of each phase of the Urban Ring project on specific environmental resource categories for the proposed alternatives. Impact levels were based on the following criteria:

- **Low** – Low level of impact to resource areas; impacts will require minimal amount of impact mitigation and/or additional environmental permitting.
- **Medium** – Moderate amount of impact to resource areas; impacts will require a moderate amount of impact mitigation and/or additional environmental permitting.
- **High** – Maximum amount of impacts to resource areas; impacts will require maximum amount of impact mitigation and/or additional environmental permitting.

Table 5-1
Air Quality Impacts of the Urban Ring Alternatives Compared to the No-Build Case

Effect*	TSM			A1, A2, B	Rail (Kenmore Alignment)		Rail (BU Alignment)
	Phase 1 2003	Phase 2 2010	Phase 3 2025	Phase 2 2010 TSM+BRT	Phase 3, Alt. A1 2025 TSM+BRT+LRT	Phase 3, Alt. A2 2025 TSM+BRT+RTL	Phase 3, Alt. B 2025 TSM+BRT+LRT
VMТ** Reduction	14,150	4,500	8,100	52,500	355,200	384,200	369,600
VOC Reduction (kg/day)	12	3	5	39	468	475	467
CO Reduction (kg/day)	140	37	48	435	6,360	6,355	6,237
NOx Reduction (kg/day)	18	5	7	76	544	578	560
CO₂ Reduction (kg/day)	6,889	2,191	3,944	25,561	172,941	187,061	179,952
Methane Reduction (kg/day)	0.8	0.2	0.4	2.9	19.2	20.7	20.0

* Relative to the base case.

** Vehicle miles traveled.

Table 5-2
Noise Sensitive Receptors (FTA Category 2) Located within 500 Feet
of the Corridor between Kendall Square and the Charles River Crossing*

Description	Use
Marriott Hotel - Kendall Square	Hotel
Residence Hotel - Kendall Square	Hotel
Edgerton House	MIT Student Housing
Building NW30 (under renovation)	MIT Student Housing
Albany Street Shelter	Drug Rehabilitation Center
Simmons Hall (under construction)	MIT Student Housing
Sidney St./Pacific St. (under construction)	MIT Student Housing
Westgate Apartments	MIT Student Housing
Waverly St./Chestnut St. Apartments	Residential Housing
Hyatt Hotel	Hotel

* Based on Grand Junction Corridor alignment.

Table 5-3
MIT Laboratories with Vibration Sensitive Equipment (FTA Category 1)

Building No.	Description
MIT Building 48	Parsons Hydrodynamics Wave Tank Lab.
MIT Building 44	Cyclotron
MIT Building 24	Potential location of MEG machine
MIT Building N9	Superconducting Generator Test Facility
MIT Building N10	High Voltage Research Lab.
MIT Building NW12	Nuclear Reactor Lab.
MIT Building NW13	Linear Accelerator
MIT Building NW14	Nuclear Magnetic Resonance Lab.
MIT Building NW21	Nabisco Lab.
MIT Building NW17	Laser Interferometer Gravitational Wave Lab.
MIT Building NW22	Plasma Science and Fusion Lab.

Table 5-4
Summary of Noise Impacts for Each Alternative
(Number of Buildings Impacted by Land Use Category)

Alternative/Description	Impact Condition			Severe Impact Condition		
	1	2	3	1	2	3
BRT - Busway (Grand Junction Alignment)	0	9	1	0	1	1
A1/A2 - Underground Rail (Grand Junction Alignment)	0	0	0	0	0	0
A1/A2 - Underground Rail (Vassar St. Alignment)	0	0	0	0	0	0
B - LRT At-Grade (Grand Junction Alignment)	0	7	19	0	5	25

Table 5-5
Summary of Vibration Impacts by Alternative
(Number of Buildings Impacted by Land Use Category)

Alternative/Alignment	Impact Condition Land Use Category		
	1	2	3
BRT Alternative - Busway (Grand Junction Alignment)	0	0	0
A1/A2 Alternative - Underground Rail (Grand Junction Alignment)	7	0	0
A1/A2 Alternative - Underground Rail (Vassar Street Alignment)	2	0	0
B Alternative - LRT At-Grade (Grand Junction Alignment)	8	0	0

Table 5-6
Sensitive EMI Receptors at MIT

Building Number	Research/Equipment/User
NW21, NW22	Plasma Science and Fusion Center
NW 17	Laser Interferometer
	Gravitational Wave Observatory
NW 14	Nuclear Magnetic Resonance
NW 13	Linear Accelerators
NW 12	Nuclear Reactor
N10	High Voltage Research Lab
N9	Super-conducting Generator Facility
44	Cyclotron
48	Wave Tank
24	Potential location of MEG Machine

Table 5-7
DC Magnetic Field Impacts in Milligauss (mG)

Lateral Distance from Track Centerline, At Distances Beyond	Light Rail at Grade Alternative B	Light Rail at 50' / 80' Depth Alternative A1 (either variation)	Heavy Rail at 50' / 80' Depth Alternative A2 (either variation)
	Field Levels		
15 feet	1,364 mG	143 mG / 56 mG	57 mG / 24 mG
30 feet	378 mG	111 mG / 50 mG	46 mG / 22 mG
60 feet	97 mG	59 mG / 36 mG	27 mG / 16 mG
120 feet	25 mG	20 mG / 17 mG	10 mG / 8 mG
240 feet	6.1 mG	5.7 mG / 5.4 mG	2.8 mG / 2.6 mG

Table 5-8
Comparison of EMI Potential Impact Among the Alternatives

Alternative Description (All Alignments / Variations)	EMI Ranking. Relative to 1% of the Geomagnetic Field (@ 30 ft)
Alt. B, Light Rail at grade	69
Alt. A1, Light Rail, 50' depth	20
Alt. A1, Light Rail, 80' depth	9
Alt. A2, Heavy Rail, 50' depth	8
Alt. A2, Heavy Rail, 80' depth	4

Table 5-9
Potential Impacts of Phases and Alternatives to Historic Areas

Phase / Alternative	City	Transportation Method	Historic District	Impact
Phase 2	Chelsea/Everett/Medford/Somerville	Bus – Existing Roadway, Busway	None	N/A
	Cambridge	Bus – Existing Roadway, Busway	Cottage Farm H.D.	Medium
		Bus – Existing Roadway, Busway	East Cambridge H.D.	Medium
		Bus – Existing Roadway, Busway	Hastings Square H.D.	Medium
	Brookline	Bus – Existing Roadway, Busway	Charles River Basin H.D.	High
		Bus – Existing Roadway, Busway	Cottage Farm H.D.	Medium
		Bus – Existing Roadway, Busway	Beacon Street H.D.	Medium
	Boston	Bus – Existing Roadway, Busway	Longwood H.D.	Medium
		Bus – Existing Roadway, Busway	Olmstead Park System	Medium
		Bus – Existing Roadway, Busway	Fenway/Kenmore Neigh.	Medium
		Bus – Existing Roadway, Busway	Parker/Mission Hill Neigh.	Medium
		Bus – Existing Roadway, Busway	Lower Roxbury Indust. Area	Medium
		Bus – Existing Roadway, Busway	Charles River Basin H.D.	High
Phase 3, Alternative A1 – Kenmore Alignment (LRT)	Chelsea/Everett/Medford	(See Phase 2)	None	N/A
	Somerville	LRT – At Grade and Tunnel	Mt. Vernon H.D.	High
	Cambridge	LRT – Tunnel	Hastings Square H.D.	High
		LRT – Tunnel	Lechmere Point H.D.	High
		LRT – Tunnel	Winter Street H.D.	High
		LRT – Tunnel	East Cambridge H.D.	High
	Brookline	LRT – Tunnel	Charles River Basin H.D.	Medium
		LRT – Tunnel	Cottage Farm H.D.	High
		LRT – Tunnel	Beacon Street H.D.	High
	Boston	LRT – Tunnel	Longwood H.D.	High
		LRT – Tunnel	Back Bay Rd./Back Bay West	High
		LRT – Tunnel	Olmstead Park System	High
		LRT – Tunnel	Fenway/Kenmore Neigh.	High
		LRT – Tunnel	Parker/Mission Hill Neigh.	High
		LRT – Tunnel	Lower Roxbury H.D.	High
		LRT – Tunnel	Frederick Douglas H.D.	High
		LRT – Tunnel	Lower Roxbury Indust. Area	High
		LRT – Tunnel	St. Margaret/Boston St. H.D.	High
		LRT – Tunnel	Crescent Ave. H.D.	High
		LRT – Tunnel	Dudley Station H.D.	High
		LRT – Tunnel	Roxbury Highlands H.D.	High
		LRT – Tunnel	Mt. Pleasant H.D.	High
		LRT – Tunnel	Dudley Triangle H.D.	High
		LRT – Tunnel	Humphrey's/East Cottage St. H.D.	High
		LRT – Tunnel	Pleasant St. North H.D.	High
		LRT – Tunnel	Charles River Basin H.D.	Medium

(Table 5-9 continued)

Phase / Alternative	City	Transportation Method	Historic District	Impact
Phase 3, Alternative A2 – Kenmore Alignment	Chelsea/Everett/Medford	(See Phase 2)	None	N/A
	Somerville	RT – At Grade and Tunnel	Mt. Vernon H.D.	High
	Cambridge	RT – Tunnel	Hastings Square H.D.	High
		RT – Tunnel	Cottage Farm H.D.	High
		RT – Tunnel	East Cambridge H.D.	High
		RT – Tunnel	East Cambridge H.D.	High
	Brookline	RT – Tunnel	Charles River Basin H.D.	Medium
		RT – Tunnel	Cottage Farm H.D.	High
		RT – Tunnel	Beacon Street H.D.	High
		RT – Tunnel	Longwood H.D.	High
	Boston	RT – Tunnel	Back Bay Rd./Back Bay West	High
		RT – Tunnel	Olmstead Park System	High
		RT – Tunnel	Fenway/Kenmore Neigh.	High
		RT – Tunnel	Parker/Mission Hill Neigh.	High
		RT – Tunnel	Lower Roxbury H.D.	High
		RT – Tunnel	Frederick Douglas H.D.	High
		RT – Tunnel	Lower Roxbury Indust. Area	High
		RT – Tunnel	St. Margaret/Boston St. H.D.	High
		RT – Tunnel	Crescent Ave. H.D.	High
		RT – Tunnel	Dudley Station H.D.	High
		RT – Tunnel	Roxbury Highlands H.D.	High
		RT – Tunnel	Charles River Basin H.D.	Medium
Phase 3, Alternative B – B.U./Park Drive Alignment (1 RT)	Chelsea/Everett/Medford	(See Phase 2)	None	N/A
	Somerville	LRT – At Grade and Tunnel	Mt. Vernon H.D.	High
	Cambridge	LRT – At Grade and Tunnel	Hastings Square H.D.	High
		LRT – Tunnel	Charles River Basin H.D.	Medium
	Brookline	LRT – Tunnel	Cottage Farm H.D.	High
		LRT – Tunnel	Beacon Street H.D.	High
		LRT – Tunnel	Longwood H.D.	High
	Boston	LRT – Tunnel	Olmstead Park System	High
		LRT – Tunnel	Fenway/Kenmore Neigh.	High
		LRT – Tunnel	Parker/Mission Hill Neigh.	High
		LRT – Tunnel	Lower Roxbury H.D.	High
		LRT – Tunnel	Frederick Douglas H.D.	High
		LRT – Tunnel	Lower Roxbury Indust. Area	High
		LRT – Tunnel	St. Margaret/Boston St. H.D.	High
		LRT – Tunnel	Crescent Ave. H.D.	High
		LRT – Tunnel	Charles River Basin H.D.	Medium

Table 5-10
Number of Hazardous Material Release Sites in the Vicinity of each Phase and Alternative

Phase/Alternative	Boston	Chelsea	Everett	Medford	Somerville	Cambridge	Brookline	Total
Phase 2 BRT	45	11	14	0	19	18	3	110
Phase 3, Alternative A1	29	0	0	0	6	14	0	49
Phase 3, Alternative A2	29	0	0	0	10	14	0	53
Phase 3, Alternative B	16	0	0	0	14	18	1	49

Table 5-11
Impact Potential Summary Table

Phase/Alternative	Air Quality	Vibration Impacts	Noise Impacts	EMI Impacts	Historic Sites	Archaeological Sites	Parklands/ Open Space	Wetland Resources	Hazardous Waste
Phase 1 – TSM	Low	Low	Low	Low	Low	Low	Low	Low	Low
Phase 2 – BRT	Low	Low	Medium	Low	High	Low	High	High	High
Phase 3 – Alternative A1	Low	Low-Med	Low	Low-Med	High	Medium	Low	Medium	High
Phase 3 – Alternative A2	Low	Low-Med	Low	Low	High	Medium	Medium	Medium	High
Phase 3 – Alternative B	Low	Medium	High	High	High	Medium	Low	Medium	High

Chapter 6

**ECONOMIC DEVELOPMENT AND
LAND USE**

6.0 ECONOMIC DEVELOPMENT AND LAND USE

This chapter analyzes the potential impact of the Urban Ring alternatives on economic development and land use. The analysis provides an in-depth look at the amount of employment and residential development projected to occur around the stations associated with each of the alternatives, as well as a breakdown of demographic data equity issues. The results are organized around station catchment areas and the five geographic segments of the Corridor. The analysis shows how the alternatives compare to each other on such measures as the amount and types of population, and development within walking distance of the proposed station locations in the base year and the year 2025. Also included is a discussion addressing the potential of the Urban Ring alternatives to support development in the Corridor beyond the adopted 2025 land use projection. Reference is made to a series of Urban Ring station concepts that were developed cooperatively with the Corridor jurisdictions showing potential station configurations and the types of land use that could be supported around such stations.

6.1 Alternatives Evaluated and Measures Employed

The economic development and land use impacts of only the three rail alternatives (A1, A2, and B) were analyzed.

- Alternative A1 - (Kenmore) LRT + BRT + TSM
- Alternative A2 - (Kenmore) HR + BRT + TSM
- Alternative B - (BU/Park Drive) LRT + BRT + TSM

The alignments for Alternatives A1 and A2 are the same south of Sullivan Square, utilizing a tunnel concept under the Charles River linking with all three Green Line Branches and the Framingham Commuter Rail Line at Kenmore. Alternative A1 would employ Light Rail technology and Alternative A2 would use Heavy Rail. Alternative A1 uses Light Rail technology in a new alignment west of the Orange Line between Sullivan Square and Assembly Square, whereas Alternative A2 joins the existing Orange Line at Sullivan Square. Alternative B crosses the Charles River in tunnel in the vicinity of Boston University/Park Drive using Light Rail technology.

These alternatives represent the final configuration of the three-phased Urban Ring project. Each of the three phases would build on the proceeding phase towards achieving the desired Phase 3 rail (heavy or light) configuration. The economic and land use analysis was applied only to Phase 3 of the Urban Ring alternatives, representing year 2025 conditions. While economic development analysis was not performed for Phase 1 (TSM service, year 2003) and Phase 2 (Bus Rapid Transit service, year 2010) of the Urban Ring, qualitative trends can be discerned from the cumulative year 2025 Phase 3 analysis results

For the analysis, a series of measures was applied to each of the Phase 3 rail alternatives. These measures identify various socioeconomic characteristics that will improve with the greater accessibility provided by the Urban Ring. These characteristics include the number of economic target zones accessible to the proposed transit alignment, the number of employees, the population, and the number and types of households. In addition, this analysis included minority population as a demographic factor. The analysis looks at the amount of these measures currently located (in 1990 and 1995¹) and planned to be located (in 2025) within areas assumed to be impacted by the proposed Urban Ring stations. The “effectiveness” of a given alternative is dependent upon the relative magnitude of each measure, the greater magnitude assumed to indicate higher effectiveness.

¹ The year 1990 data was updated by CTPS to year 1995 for employment and population data.

The land areas surrounding proposed stations are called “catchment areas” and are defined below.

The primary data source used for this analysis is from the Central Transportation Planning Staff (CTPS), which relied heavily on the U.S. Census for 1990 data. Year 2000 U.S. Census data was used for minority population statistics. Year 1995 population and employment data was developed by CTPS based on recent figures adopted by the Metropolitan Area Planning Council (MAPC). CTPS made its own projections for year 2025 conditions.

As discussed above, quantitative forecasts have not been made for Phases 1 and 2 of the project. Instead, qualitative trends can be estimated from the projections made between 1995 and 2025. Strong economic and population growth rates anticipated for the region and Corridor are based on current economic conditions. While the percentage increases in year 2003 and 2010 are expected to be similar to 2025, actual population, households, and employment numbers would be lower.

three Urban Ring alternatives for Phase 3.

A technical memorandum issued on June 15, 2001 described the likely socioeconomic impact of the three Urban Ring alternatives for Phase 3.

6.2 Summary of Socioeconomic Data

Table 6-1 summarizes population and employment data for the Urban Ring catchment areas compared to the entire MAPC region. The table shows that population growth in the Urban Ring Corridor is expected to increase by approximately 34 percent between 1990 and 2025, over three times greater than the MAPC area (11 percent). Employment in the Corridor over the same period is projected to increase by approximately 81 percent compared with 26 percent for the MAPC area.

Socioeconomic indicator data are shown in Table 6-2 for the three alternatives. The table shows that there are only small differences between the alternatives for each of the socioeconomic indicators. Each alternative will serve between 311,000 and 316,000 jobs, between 242,000 and 251,000 persons, and between 95,000 to 99,000 households in 2025. Each alternative would serve approximately 35,000 households without vehicles representing approximately 43 percent of the total households in the Corridor. The socioeconomic factors for Alternative B would be only 1 to 4 percent greater than for Alternative A. Alternative B would serve slightly more jobs (2 percent) and population (4 percent) than Alternative A due to a longer route and more stations served.

6.3 Analysis Approach

The analysis utilized Metropolitan Planning Council (MAPC) forecasts to the year 2025 to reflect growth rates developed through the Regional Transportation Plan Update Process. Based on analysis of travel demand and with input received through the community involvement process, a number of potential station locations were identified for each of the proposed alignments. Depending on the mode of service offered at each location, the areas from which a station draws its patrons were identified. These areas are called catchment areas. The standard catchment area for buses is 1/4-mile. For stations served by Bus Rapid Transit service, the catchment areas are larger as BRT stations offer improved service over traditional buses. BRT catchment areas are defined as all land within a 1/3-mile radius of the station. Stations served by light rail and rapid transit have an even larger catchment area, which includes all land within a 1/2-mile radius around the station. Due to the close proximity of many of the stations along the Urban Ring, catchment areas overlapped in many areas. To avoid double-counting overlapping areas, catchment areas were truncated at the point of overlap.

The context of the analysis provides estimates of the potential impacts of the Urban Ring through 2025. The analysis reflects the use of Metropolitan Area Planning Council (MAPC) forecasts. The updated forecasts generated by MAPC are being used in various other local planning efforts including the Arborway LRT Restoration Feasibility Study, the North Shore MIS and the Regional Transportation Plan. The numbers reflect growth rates developed for the Regional Transportation Plan Update Process, which have become available such as improved demographic and economic indicators. The new projections reflect the use of historical data from 1990 and 1995. This data has been used to create a comparison of the three proposed rail alternatives.

The evaluation includes analysis of minority population. This information combined with information on low-income households and automobile ownership will facilitate comparisons of the alternatives with regard to environmental justice factors and transit dependency.

The model used by CTPS to develop the numbers used in this analysis is based on a set of computer-based supply and demand models. The primary inputs used in the model are the study area population, employment, household and socioeconomic characteristics, parking costs, as well as selected characteristics of the regional transportation system. The model accounts for demographic changes throughout the entire eastern Massachusetts area.

The model contains four important steps. In the first step, total travel trips are calculated based on demographic characteristics in individual analysis zones. The second step of the model calculates how trips are distributed throughout the region. The third step calculates the model split between auto and transit trips. This calculation considers many factors including costs and travel times associated with each trip. The fourth step in the model assigns each trip to a network of specific roadways and transit services.

To develop the numbers used in this analysis, the model was run and adjusted several times until it replicated the existing highway and transit volume counts at an acceptable level of accuracy within the study area. The calibrated model was then applied to test the proposed transit alternatives.

6.3.1 Analysis by Segments

The Corridor is quite long, running approximately 15 miles through parts of six municipalities: Boston, Brookline, Cambridge, Somerville, Everett and Chelsea. For ease in discussing and comparing alternatives on a more localized basis, the Corridor has been broken into five segments as shown in Figure 6-1. There is no variation among the alternatives for Segment 5 (South Boston Seaport Area), and therefore, that segment is not included in this comparative analysis. The five segments are:

- Segment 1: Logan Airport to Wellington
- Segment 2: Assembly Square to Kendall Square
- Segment 3: MIT to Ruggles Station
- Segment 4: Washington Street/Dudley Square to UMass/Boston
- Segment 5: South Boston Seaport Area

6.3.2 Station Catchment Areas

The Central Transportation Planning Staff (CTPS) provided much of the key input to this report. For the analysis of station catchment areas, CTPS used its Geographic Information System (GIS) to describe current conditions and forecasts within a precisely defined zone, called a "station catchment area," around

each individual station in each of the Urban Ring alternatives. Sources of data included federal, state and local databases. Table 6-3 lists the proposed stations for each of the three alternatives by city and segment.

A station catchment area is an area surrounding a transit station from which the majority of the transit service's walk-in passengers will be drawn. As such, it is the area within which existing and future land uses will benefit the most by the improved accessibility associated with new or improved transit service. This is especially true for office, residential and institutional uses, which generate daily commuter travel to and from work places. Retail and entertainment uses also generate ridership but at lower volumes since they tend not to attract the same riders on a daily basis. A fundamental assumption when analyzing economic benefits of the Urban Ring, therefore, is that activities located within the station catchment areas will benefit from the addition of new transit service and enhanced mobility, and these benefits will translate into additional investments and increased economic capacity in the Urban Ring impact area.

Station catchment areas for the Urban Ring project are defined as circles having a radius of 0.325 miles (1,716 feet) for stations served by Bus Rapid Transit (BRT), and a radius of 0.5 miles (2,640 feet) for stations served by rail vehicles. These distances are based on observed behavior which indicates that transit users will walk slightly further to access rail service compared to BRT service and are consistent with CTPS's approach to modeling impacts of various transit modes. Figures 6-1 through 6-4 show the station catchment areas for each alternative.

6.4 Assessment Criteria

Analysis of the economic development potential of a proposed transit system is focused on the areas where future stations will be located, rather than uniformly along the alignment. This is because the station is where patrons actually enter and depart the system. In the case of the Urban Ring, however, the stations are closely spaced, and the station analysis areas therefore overlap sufficiently to cover virtually the entire Corridor.

The analysis focuses on criteria adapted from three sources: the Federal Transit Administration (FTA), Federal Executive Order 12898 "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations," and the Executive Office of Environmental Affairs (EOEA). The thirteen criteria used in the analysis are:

1. Land use;
2. Containment of sprawl;
3. Transit-supportive Corridor policies;
4. Supportive zoning regulations near transit stations;
5. Tools to implement land use policies;
6. Performance of land use policies;
7. Reductions in local infrastructure costs achieved through compact land use development;
8. Employment;
9. Population;
10. Households;
11. Households without Automobiles;
12. Households below poverty level; and
13. Minority population.

Criteria 1 through 7 have been established by the FTA to address the linkages between transportation and economics. Since the passage of the TEA-21 authorizing legislation in 1998, FTA has revised its criteria for rating projects and has issued draft rules for evaluating candidate projects for discretionary New Starts funding under Section 5309, which incorporate careful consideration of the economic impacts of the proposed project.

The criteria include detailed consideration of economic development, land use policies, and anticipated future impacts of a project on a proposed transit corridor and adjacent areas. This analysis is particularly relevant to several of FTA's criteria. It examines how existing land uses will support the Urban Ring and how they might change over time. This economic impact analysis also considers how transit supportive policies and zoning regulations within the Corridor might improve the impact of this new transit service. To estimate these land use impacts, the socioeconomic characteristics examined in this analysis include current statistics of, as well as projections of employment, population, total households and transportation for disadvantaged households.

The analysis also explores how the new Urban Ring will increase accessibility to the many economic development target zones within the six Compact Municipalities. Details for each of the thirteen assessment criteria are presented separately below.²

6.4.1 Land Use

The Urban Ring has long been home to some of the region's leading institutions – including four universities and two medical centers – interspersed amidst industrial, warehousing, and transportation uses. Today, thanks to their proximity to Downtown and the Corridor's established institutions, many of these obsolete industrial sites have found new economic life as homes to major knowledge-based companies.

The uneven and transitional nature of much of the Urban Ring can be seen in a profile of the largest non-residential uses in the Corridor. Two of the four land uses with the largest number of square feet of development belong to the knowledge sector. These are higher education, with 17.4 million square feet, and office use, with 15.9 million square feet. The other two largest non-residential uses belong to the older industrial sector. These are warehousing, with 16.4 million square feet, and manufacturing, with 14.3 million square feet.

With the emergence of a modern economy in the Urban Ring, parts of the Corridor have assumed densities of employment that are among the highest in the Boston region. Altogether, the Urban Ring is the location of 204,139 jobs, or twelve percent of the region's total jobs. Much of the Corridor's employment is densely concentrated in well-established economic centers, such as Boston Medical Center, Longwood, and Kendall Square. Each of these areas features employment densities of more than 60,000 jobs per square mile – nearly the level of employment concentration in Downtown Boston. The Longwood area contains by far the largest number of employees, with over 31,000 jobs. Kendall/East Cambridge is next, with over 23,000 jobs.

This employment is located in intensively developed centers. The Corridor contains 108 million square feet of occupied non-residential building space. The neighborhoods with the most non-residential floor space are Longwood and MIT/Massachusetts Avenue, each of which contains over 10 million square feet of nonresidential space.

² Details are drawn from the Compact Report developed by the six Urban Ring Compact jurisdictions of Boston, Chelsea, Everett, Somerville, Cambridge, and Brookline dated September 2000.

The existing land use in the Urban Ring varies by segment but station locations have been selected with input from the local community and public officials to provide the best possible linkages between existing activity centers. The Compact communities of Chelsea, Everett, Somerville, Cambridge, Brookline, and Boston, however, have simultaneously directed the Urban Ring to provide service to as many Economic Target Zones as possible. In total, 77 target zones have been identified and incorporated into the assessment of the proposed alternatives. Section 6.5 shows the relationship of the Economic Target Zones to station catchment areas.

6.4.2 Containment of Sprawl

Because the Corridor is in rapid transition from its historical uses, the Urban Ring continues to contain swaths of “rust belt” areas that reflect its historical role as the provider of storage, transportation and manufacturing for the region. Among these areas are significant areas of vacant or underdeveloped land, much of it consisting of obsolete land uses. Altogether, there are 3,674 acres within zones that are predominantly vacant and underutilized. These zones include portions of Columbia Point, South Bay, the North Point, the Rutherford Avenue area, and the Assembly Square area, as well as areas in Everett and East Boston.

These vacant and underutilized areas have the potential to absorb a significant portion of the region’s knowledge-based growth. They are attractive to these industries because they tend to be juxtaposed to areas that are either highly developed or undergoing rapid development.

The Urban Ring is designed to promote movement within metropolitan Boston’s Urban core. The proposed project will provide links within existing urban neighborhoods while fostering growth and economic opportunities for expansion in these same communities. By enhancing transportation and connectivity within these urban neighborhoods new opportunities and redevelopment opportunities will occur without promoting sprawl in the metropolitan area.

6.4.3 Transit Supportive Corridor Policies

As the Urban Ring Corridor is consolidated as an element of the high-density downtown core, the impacts of auto use on arterial streets, on residential quality of life in adjacent neighborhoods, and on air quality have increased efforts to reduce auto use and increase transit use. These efforts require finding a balance among competing imperatives. On the one hand, the Corridor cannot support auto use levels characteristic of the suburbs. At the same time, the limitations of the transit system in the Urban Ring mean that private development cannot be expected to attract tenants and employees if auto use is restricted to the levels achieved in Boston’s Downtown. As a result of these pushes and pulls, the Compact municipalities have deployed a wide range of techniques to reduce reliance on the automobile and increase transit use.

The municipalities’ efforts include planning and policy documents that state the need for better transit. Zoning and other regulations directly encourage transit use, by requiring employers to set transit share goals, or by concentrating high-density development near existing transit stations. Municipalities also have made efforts to create new transit-oriented developments, by ensuring that projects are transit-accessible. In some cases, municipalities are taking a more active role by operating shuttle bus services to link businesses with existing MBTA stations. Finally, municipalities have placed limits on parking, as a means of encouraging transit use. Table 6-4 lists these efforts.

Taken together, the measures instituted within the Urban Ring are unique to the region. They insure that transit ridership on an Urban Ring system would reach higher levels than anywhere else in the region, with the exception of Boston’s Downtown.

Implementation of the Urban Ring provides the MBTA, metropolitan Boston, and the FTA with opportunities to promote transit supportive Corridor policies on a large and substantive basis. Many of the compact communities have already progressed with transit supportive policies in their own communities. The Urban Ring, however, provides a unique forum for this group of neighbors to develop a shared transit supportive policy. Notable among these communities is the City of Cambridge's work in traffic calming. Elements of traffic calming, as well as lessons learned from other compact community members, will be incorporated into the final design of the Urban Ring.

6.4.4 Supportive Regulations Near Transit Stations

Transit supportive zoning regulations are key to maximizing benefits from the addition of Urban Ring infrastructure into a community. The implementation of the Urban Ring would provide local communities with the opportunity to leverage latent opportunities for growth. The City of Boston and other compact communities have provided leadership in this area by its recent development of Transit-Oriented Design standards (TOD). Overlay zoning may also be a potential method for members of the compact communities to direct growth in the vicinity of Urban Ring stations.

The surge of development in the Urban Ring, particularly where that growth has occurred in close proximity to established residential areas, has led the Commonwealth and the Compact municipalities to establish a range of strategies that attempt to reduce the reliance on auto access by managing parking inventory. The Commonwealth and Boston have installed parking freezes in East Boston and South Boston. The Compact municipalities, particularly those with established high-density employment centers and some access to the transit system have developed significant policies to manage parking supplies and encourage transit use. In Boston, most of these regulations apply at the neighborhood level. In other municipalities, regulations typically operate citywide. Table 6-4 summarizes transit-supportive regulations near transit stations.

6.4.5 Tools to Implement Land Use Policies

The Federal, Commonwealth and municipal governments have made capital investments in the Urban Ring. These investments range from brownfield site remediation, to roadway improvements, to the creation of open space. In keeping with the Compact's vision for the Urban Ring, these investments will improve the environment of the Corridor, support modern economic uses, and provide amenities for residents. In addition to these infrastructure improvements, the Federal and State governments have designated large areas of the Corridor Economic Target Areas, Economic Opportunity Areas, and an Empowerment Zone. These designations allow private developers to take advantage of preferential loans and tax incentives. Table 6-5 lists these public programs and investments.

6.4.6 Performance of Land Use Policies

The previous FTA criteria "Tools to Implement Land Use Policies" goes hand in hand with the criteria "Performance of Land Use Policy. Provision of alternative transportation services can assist local businesses in maintaining their communities' optimal ratio of parking spaces to square footage of development. Similarly, the addition of transportation services can make existing land use policies work better. For example the linkage of the regional parks to the rest of the community will be enhanced, improving access to these amenities for all persons in the region.

The government policies and investments designed to concentrate growth in the Urban Ring have produced significant success. Established employment centers within the Corridor continue to grow. At the same time, the Boston region's strong economy has begun to respond to the years of municipal effort to direct growth to the Corridor's transitional areas. A promising number of new developments, renovations, and facility expansions have brought new jobs and residents to the Urban Ring. Table 6-6 lists these developments.

6.4.7 Reductions in Local Infrastructure Costs Achieved Through Compact Land Use Development

A strong reason in favor of completion of this project is the implications for the preservation of the MBTA's existing infrastructure. Implementation of the Urban Ring would eliminate an estimated 34,000 transfers per day. Due to its ability to divert existing transit riders off of the existing MBTA transit system, the Urban Ring has the ability to leverage additional *new* riders on other parts of the system. The previous analysis of the MBTA system was developed with an unconstrained transportation model. This meant that the model was unable to assess when the system had reached peak capacity. The development of projects in the region were, therefore, not limited by lack of transit capacity. This is particularly relevant to the Green Line. The Urban Ring will provide connections to all four branches of the Green Line allowing it to carry additional passengers as the Urban Ring frees up capacity in the central and most crowded sections of the existing system.

6.4.8 Employment

In 1996, the Compact projected that the Ring will absorb over 15 million square feet of non-residential development by 2020 including medical, educational, retail, industrial, office, and laboratory uses. This growth in building space will support a remarkable employment growth in the Corridor, representing a projected 37,000 new jobs by 2020.

The knowledge-based industries are the fastest growing sectors of the region's economy. Because the Urban Ring, with its numerous medical and educational institutions, is an attractive location for knowledge-based industries, the pace of the Urban Ring's transformation is accelerating. The non-residential land uses that will grow the most will be those serving the knowledge sector. Office space will grow by 4.8 million square feet, a 30 percent increase. Laboratory space will grow by 2.7 million square feet, an 84 percent increase.

Established areas are projected to see the highest absolute growth. The Longwood area, for example, will gain 2.1 million square feet of non-residential building space, and 4,333 jobs. Emerging areas are projected to see the highest growth rates. Assembly Square, for example, is projected to increase its non-residential building space by 92 percent, and its employment by 66 percent.

In fact, the Urban Ring is projected to grow faster than the region as a whole. The Ring is projected to see an 18 percent increase in employment, while the region is projected to see only 15 percent growth in jobs. The Ring is now not only sharing in the region's economic prosperity, it is at the forefront.

Furthermore, since the growth projections were created in 1996, the Boston region's economy has grown at an accelerating rate. Current development trends in the Urban Ring, particularly in Cambridge and Longwood, indicate that the Corridor will exceed the 1996 growth projections. This is particularly true since fast-growing knowledge-based industries are driving the Urban Ring's economic development.

Table 6-7 shows employment within the catchment areas of each alternative in the year 1995 and the growth that is forecast to the year 2025. Employment and employment growth are considered particularly important criteria for decisions at the state and local levels regarding funding of proposed transportation projects.

The Urban Ring Corridor would experience a 48 percent increase in employment between 1995 and 2025. For all segments combined, the greatest employment in year 2025 will be served by Alternative B, although it would represent less than a 2 percent increase over Alternative 1. The most significant difference between the alternatives is a greater number of stops associated with Alternative B.

Year 2025 employment will be heavily concentrated in Segment 3, with over 45 percent of jobs within the Corridor located in that segment. For Segment 2, Alternative B would serve approximately 16 percent more employees (9,796 employees) than Alternative A. The greatest increase in employment would occur in Segment 5, which would experience growth 4.5 times the 1995 levels

6.4.9 Population

The Urban Ring is the location of established residential neighborhoods, most of which have served for generations as the homes of blue-collar workers and of successive waves of immigrants. Altogether, the Corridor contains 221,785 residents, or nearly eight percent of the region's total. The most populous neighborhoods are Crosstown/South End, the Fenway, Chelsea, and East Boston, each of which is home to more than 25,000 residents.

Population densities within the Urban Ring are highly supportive of transit service. Some neighborhoods, including portions of Crosstown/South End, East Cambridge and East Boston, contain residential concentrations in excess of 30,000 per square mile, similar to the population density of Boston's Back Bay. Much of the Fenway contains densities in excess of 60,000 per square mile, about the density of Boston's North End. Somerville is the densest city in New England, and in fact is one of the ten densest cities in the country. These concentrations are highly advantageous for transit, particularly since Urban Ring residents own only 0.8 automobiles per household, and are thus among the most transit-dependent residents in the region.

Already the location of dense neighborhoods, the Urban Ring is expected to increase its residential population by 16,544 by 2020, a 7 percent increase. Several neighborhoods each will gain more than 2,000 residents. These are Crosstown/South End, Boston University, Cambridgeport, and MIT/Massachusetts Avenue. Cambridgeport's projected 2,990 new residents represents a 46 percent increase for that neighborhood, the highest residential growth rate in the Urban Ring. With this growth, portions of Boston University, Cambridgeport, and MIT/Massachusetts Avenue are expected to attain densities of more than 30,000 residents per square mile.

This growth reflects a dual role of Urban Ring neighborhoods: On the one hand, traditional immigrant neighborhoods such as Roxbury, Dorchester, Chelsea, East Boston, Everett will continue their recent growth, comparable to the growth other immigrant communities in the Eastern part of the State. On the other hand, several neighborhoods will absorb the regional core's on-going growth in higher income populations. Among these are Cambridgeport, North Point, and Kendall Square.

Table 6-8 reports the total population residing within the station catchment areas of each alternative by segment in 1995 and 2025, and the absolute and percent changes. For all segments combined, the largest numbers of residents in the year 2025 will be served by Alternative B. By 2025, over 250,000 people are forecast to be living within the catchment areas of Alternative B Urban Ring stations, which is slightly greater than either of the other two alternatives.

Segment 3 (MIT to Ruggles) will contain the highest concentration of residents within the Corridor. Approximately 113,000 people are projected to be living within Segment 3 catchment areas by the year 2025, which represents about 45 percent of the Corridor's population.

6.4.10 Households

Trip making tends to be based on households as much as on the population that makes up those households. It is therefore important to examine the number and types of households within the Urban Ring catchment areas. In addition to considering the total number of households predicted to be within the

catchment areas, the number of households below the poverty level and the number of households without any private automobile are reported. These latter indicators are important as a measure of “transit dependency” and households whose residents make high levels of transit trips. However, due to the highly uncertain nature of projections of such indicators, statistics on these two indicators are not projected out into future years, and are based strictly on the 1990 census. Household data was developed by CTPS for 1995 and projected to year 2025. Census data for household characteristics is scheduled for release in 2002.

Table 6-9 reports the total number of households within the station catchment areas of each alternative in 1995 and 2025, as well as the absolute and percent changes. For all segments combined, the largest number of households in the year 2025 will be served by Alternative B, largely because this alternative has additional stops in Somerville and the Boston University area (via both Bus Rapid Transit and light rail). In 2025, Alternative B would contain a total of 99,710 households or 3.5 percent more than Alternative A.

6.4.11 Households Without Vehicles

Households without vehicles can be considered a good indicator of transit dependency. In 1990, households with no private vehicle represented approximately 43 percent of all households in the Corridor. Table 6-10 reports the actual number of households with no vehicle based on 1990 census data, the most recent available. Completion of the Urban Ring would improve transportation options to all people in the Urban Ring Corridor. The results, however, would especially benefit those individuals who are dependent on public transportation.

6.4.12 Households Below Poverty

Similar to households without vehicles, those households that fall below the poverty level are most dependent upon public transportation services for their mobility needs. In support of the Executive Order, the Executive Office of Environmental Affairs of the Commonwealth of Massachusetts (MEPA) issued a draft Environmental Justice Policy in December 2000.³ This policy supports environmental justice for all residents of Massachusetts. As a project seeking support from both the Commonwealth of Massachusetts and the FTA, the Urban Ring MIS is identifying the effects of the Urban Ring on households below the poverty level.

Table 6-11 summarizes households below the poverty level in 1990. Alternative B has a slightly higher concentration of low-income households within its catchment areas compared to Alternatives A1 and A2, but the difference is only 1 percent. Households below the poverty level represent approximately 21 percent of all households within the Corridor.

6.4.13 Minority Population

The effect of a project on minority populations is also one of the criteria used to measure Environmental Justice. A 1994 Presidential Executive Order directed every federal agency to make environmental justice part of its mission by identifying and addressing the effects of all programs, policies, and activities on “minority populations and low-income populations.” As such, the FTA is examining the effects that projects will have on these communities. As a project seeking support from both the Commonwealth of

³ Environmental Justice Policy of the Executive Office of Environmental Affairs, Public Comment Draft, December 19, 2000.

Massachusetts and the FTA, the Urban Ring MIS is identifying the effects of the Urban Ring on minority populations. Minority population data was based on year 2000 U.S. Census data.

Table 6-12 provides information on the number of minorities within each station catchment area served by segment for each alternative. None of the alternatives stand out as having a significant advantage over another in terms of serving minority populations. Approximately 52 percent of the people served by each alternative are minorities. The difference between the alternative, which serves the highest and lowest number of minorities is less than 1 percent

6.5 Relationship of Catchment Areas to Economic Target Zones

In order to facilitate comparison of the economic development impacts of the Urban Ring alternatives, the six municipalities in the Urban Ring Corridor, which formed the original Compact in support of the Urban Ring, identified a total of 77 existing Economic Target Zones that are located in or adjacent to the station catchment areas. Federal, state and/or local agencies have designated these zones as locations where they intend to stimulate private and public investment, and create new or improved housing, commercial business opportunities, employment, as well as create new or improved public infrastructure. The provision of improved accessibility via new transit service can strongly support and enhance such efforts.

The 77 Economic Target Zones are distributed among the six Compact Municipalities as follows:

<u>Municipality</u>	<u>Zones</u>
Boston	26
Brookline	6
Cambridge	8
Somerville	7
Everett	7
Chelsea	23

Figure 6-5 illustrates the locations of the 77 Economic Target Zones identified by six Compact Communities.

Three major categories of economic target zones, were identified by the Compact Municipalities:

- The first are zones that are currently “developed,” but nonetheless will continue to experience growth (e.g., Boston’s Longwood Medical and Academic Area, East Cambridge Riverfront, Cambridgeport).
- “Emerging” zones are those where new kinds of growth and associated changes in land use are anticipated (e.g., Tele-Com City in Everett, North Point in Cambridge).
- Several “Local Business Districts” (e.g., downtown Chelsea or Boston’s Kenmore Square, Cambridge Street) are also designated because they are targeted by the Compact municipalities for future growth, investment and economic activity.

Target zones that are located in or immediately adjacent to one or more catchment areas will experience the greatest benefit from improved transit service, assuming that transit-related land uses are planned for or exist within the area, and assuming also that supportive municipal policies are in place.

It should be noted that because Wellington Station will receive BRT Urban Ring service, a catchment area for that station appears on Figures 6-2, 6-3 and 6-4, and data for that catchment area are included in all the tables in this report. However, Wellington Station is located in Medford, which is not one of the Urban Ring Compact Communities. Therefore, no Target Zones are identified within its catchment area.

6.6 Potential to Exceed Forecasts

There are several reasons for expecting that Urban Ring Growth would exceed the growth forecasts presented above.

1. The forecasts presented in this analysis do not account for further economic development, which may be caused due to improved transit access associated with construction of the Urban Ring. Rather, as required by FTA, the forecasts are based on development already planned by Urban Ring communities assuming existing land use policies, programmed investments in new infrastructure and resulting expectations for future development. Use of existing growth forecasts creates an equitable baseline for all projects currently being planned in the Boston metropolitan area to enable comparisons of project impacts and the relative benefits of alternative transportation investments.
2. The involvement of the Compact communities in planning for the Urban Ring has brought a detailed understanding of Corridor land uses and economic activity at a level of detail that is unique for a Major Investment Study. The Compact communities have demonstrated their commitment to pursue economic activities and compatible land uses which can maximize the economic benefits of transit.
3. Many of the industries and institutions in the Urban Ring are leaders in the nation's fastest-growing markets. Seven of the "Top 10" industries that are forecast by the federal Bureau of Labor Statistics to have stronger than average employment growth for the period 1996-2006 are substantially concentrated in and near the Urban Ring.
4. Many of the industries located in the Urban Ring are also those that have been targeted by the state as the keys to its economic growth and will potentially be encouraged to expand through favorable state policies.
5. The entire eastern Massachusetts region appears to be poised for strong future growth as several important infrastructure projects in the region move toward completion. These include the Central Artery/Third Harbor Tunnel, the Logan Airport reconstruction and parking expansion, the Boston Harbor cleanup, and the revitalization of the South Boston Waterfront. Completion of these projects will enhance the region's infrastructure capacity to support any additional growth beyond that already projected. Cities such as San Diego, Vancouver, Portland, San Jose, Atlanta, and Washington DC have demonstrated that transit service can facilitate development greater than that which would otherwise occur in a location.
6. Ridership forecasts performed by CTPS are based on socio-economic and population projections for the MAPC area. The projections must equal a control total for the entire MAPC area. Therefore, individual areas may either be under- or over-represented. It is understood that due to local planning efforts, development in specific areas such as Assembly Square, Cambridgeport, and Uphams Corner, will exceed regional-based projections. However, because projections are conducted every three years, recent growth trends at the local or sub-local level will be better reflected in the next upcoming regional forecasts.

Taken together, these factors lend strong support to the belief that economic development in the Urban Ring is very likely to exceed the forecasts.

In addition to these reasons, further discussion of the Urban Ring's potential to exceed these economic development forecast will follow after data being prepared by CTPS for the focused accessibility analysis become available.

6.7 Station Concept Analyses

One of the tools used to determine the potential impact of Urban Ring service in the Corridor was the development of station concepts at locations selected by the local jurisdictions. At least one location was selected by each of the six Compact jurisdictions for analysis early in the MIS and the results presented in the Urban Ring Progress Report. At least two alternative concepts were developed for each station location to test the land use and urban design implications of different alignment options, such as above ground versus below ground stations. Building upon this previous work, the urban design exploration was expanded to all Phase 2 and Phase 3 station locations around the Corridor through development of a concept level cross-section for each station. The purpose of the urban design concepts is to begin exploring the form and scale of these stations and their relationship to surrounding land uses, both existing and planned. All the sections are conceptual only. The actual location and configuration of urban Ring stations will be developed and evaluated during the subsequent DEIR/S process for Phase 2 and, later, for Phase 3.

Appendix E describes and depicts the station concepts developed at locations around the Corridor. All station concepts are subject to further review and development in conjunction with the local jurisdictions during the environmental process.

6.7.1 Purpose

This section summarizes the process and preliminary findings of the station area concept explorations that were undertaken by the consultant team at the potential sites for station stops along the Urban Ring. The purpose of these explorations was to inform the Urban Ring jurisdiction representatives about the feasibility of locating potential Urban Ring stations at sites along the Urban Ring BRT and rail routes and the urban design development opportunities and constraints associated with these concepts. In exploring these sites, the impact of the proposed alignments was analyzed along with suggested technologies, and potential short- and long-term development scenarios. Also reviewed were the land use and urban design plans previously articulated by the jurisdictions.

6.7.2 Station Locations

The station locations investigated include those of the entire Urban Ring alignment as well as Urban Ring stations also served by the future Green Line extension to Medford. The stations listed below are associated with Phase 2 and/or Phase 3 of the Urban Ring. Phase 1 bus stops were not explored from the perspective of urban design for reasons described later in this section. The list below follows the Phase 2 and Phase 3 alignments counterclockwise around the Corridor beginning at Logan Airport. The stations are:

1. Logan Terminals, East Boston
2. Airport Blue Line Station, East Boston
3. Chelsea Commuter Rail Station, Chelsea
4. Everett Avenue / Mystic Mall, Chelsea
5. Revere Beach Parkway, Everett
6. Second Street, Everett
7. Broadway, Everett

8. Wellington, Medford
9. Assembly Square, Somerville
10. Gilman Square, Somerville
11. Union Square, Somerville
12. Sullivan Square, Charlestown
13. New Washington Street, Somerville
14. Community College, Charlestown
15. Fitchburg Street, Somerville
16. New Lechmere Station, Cambridge
17. First Street / Galleria, Cambridge
18. Kendall / MIT, Cambridge
19. MIT / Mass Avenue, Cambridge
20. Cambridgeport, Cambridge
21. BU / St. Mary's, Brookline
22. Kenmore / Yawkey, Boston
23. Fenway, Boston
24. Longwood / Louis Pasteur, Boston
25. Huntington Ave. / Green Line E, Boston
26. Ruggles / Whittier St., Boston
27. Dudley Square, Roxbury
28. Washington Street / Silver Line, Boston
29. Boston Medical Center, Boston
30. Crosstown / Albany Street, Boston
31. Biosquare, Boston
32. Blue Hill Avenue, Roxbury
33. Uphams Corner, North Dorchester
34. Edward Everett Square, South Boston
35. JFK / Umass, South Boston
36. Umass Campus / South Boston
37. Convention Center, South Boston

Refer to Appendix E for a discussion of the urban design implications for each station location and conceptual cross sections.

6.7.3 Methodology

At the beginning of the station concept exploration, the consultant team requested specific information from each jurisdiction including basemaps, current and proposed development plans and zoning. This information was discussed with the jurisdiction representatives to determine the potential long-term development of each of the sites. Further mapping systems and information were obtained including Massachusetts Road Inventory Data providing dimensions for roadway rights-of-way and its various elements. Site analysis was conducted including photographic surveys to understand the issues particular to each potential station location. Based on input received and field observations, graphically illustrated options were developed for the sites that identify required rights-of-way for the Urban Ring alignment, possible connections to other transit modes, as well as future development potentials. The urban design implications of the various technologies, alignments and profiles were then evaluated along with their potential to foster development.

6.7.4 Urban Design Implications

Each potential development scenario of the Urban Ring stations was analyzed to understand the urban design impact of the transit investment. The conclusions drawn were based on the level of positive (or

negative) effect for the urban design in that particular area, the potential for creating connections between public transit lines or creation of an intermodal transit center at a particular station, and the impact that the Urban Ring would have to foster development in a presently underutilized area.

The Urban Ring has been strategically planned to provide service to a balance of residential areas, commercial centers, cultural nodes, and large institutions. Each of these districts will present a large segment of the Urban Ring ridership, as well as provide endpoint destinations for users of this public transit. By providing improving accessibility, the Urban Ring will have the potential to upgrade the character of urban zones and to foster new development in presently underutilized areas. At each of the station locations, the investment of a public transit infrastructure will create a strong focal node for that particular area. Two appropriate local examples can be seen in the Kendall Square/MIT area and in the Davis Square area. These are two urban centers that illustrate the different types of evolution that a strong public transit system may cultivate. The area surrounding the Kendall Square/MIT station of the Red Line is a now a dense agglomeration of large institutional and commercial buildings. Its location of the Red Line has made this an attractive spot for recent development and this district has emerged as a high concentration of research and technology buildings. A second and contrasting example of the impact of a major public transit investment can be seen in Davis Square, Somerville. With the Red Line extension to Alewife and the addition of the Davis Square station stop in 1980s, this area has undergone an urban renaissance that has included a convergence of local businesses and an upgrade in the residential property values. This is a prime example of how rail transit accessibility can promote the urban maturity of an existing, established district.

Previous experience of the MBTA and other transit systems indicates that, in general, a higher level of investment in the transit infrastructure would yield a greater impact in the built environment. The Phase 1 implementation of a series of CT bus routes, while a necessary bridge toward circumferential transit for Boston and an improvement in mobility and accessibility, would not have a major urban design impact for the compact communities. The creation of a Bus Rapid Transit (BRT) system for the entire Urban Ring corridor in Phase 2 will begin to have an impact on the urban impression along the ring. This will be primarily noticeable in areas that are presently underserved such as Union Square in Somerville, Cambridgeport, or Uphams Corner in Dorchester. The linkage created between these areas and the other rapid transit rail lines will initiate urban redevelopment. The most likely scenario will be the upgrade of existing buildings and mid-scale development projects as these areas are increasingly accessible with recognizable permanent BRT station infrastructure. Past experience does not yet prove what degree of development this system of public transit will invoke in an American urban center. Given its similar technology, the forthcoming Silver Line will provide a valuable model for the assessment of this potential.

Phase 3, which signifies the implementation of a rail system, will initiate the beginning of major evolution of the urban character along the Urban Ring. Traditional community focal centers such as Dudley Square in Roxbury will have the potential to be completely revitalized. Also, potentially new emerging districts such as Everett Avenue / Mystic Mall may be completely redefined by the new development associated with the Urban Ring. The most potentially advantageous development scenario from an urban design perspective would be Alternative A2 because its higher capacity service and completely grade separated route alignment would be a more powerful catalyst for development in emerging areas and would be more effective at mitigating traffic impacts in established areas. The development of an at-grade rail solution through Cambridge in Alignment B would have less of a potential impact and would create constraints from an urban design standpoint.

Table 6-1
Comparison Of Regional And Urban Ring Corridor Growth Rates

	1990	1995	2010	2025
Population				
Urban Ring Corridor	234,088	270,804	304,003	313,839
% Growth from 1990		15.7%	29.9%	34.1%
MAPC Regional Total	2,922,934	3,044,982	3,133,587	3,245,120
% Growth from 1990		4.21%	7.2%	11%
Employment				
Urban Ring Corridor	199,400	237,616	325,285	360,269
% Growth from 1990		19.2%	63.1%	80.7%
MAPC Regional Total	1,722,189	1,708,500	1,966,683	2,175,941
% Growth from 1990		-0.8%	14.2%	26.3%

Table 6-2
Summary Of Socioeconomic Indicators By Catchment Area

		Alternative A		Alternative B	Maximum Difference*
		A1	A2		
Socioeconomic Indicators					
Employment	2025	311,252	313,203	316,384	2%
Population	2025	242,381	243,538	250,941	4%
Households	2025	96,258	96,944	99,710	4%
Households without Vehicles	1990	35,314	35,372	35,755	1%
Households below Poverty Line	1990	17,204	17,235	17,416	1%
Minority Population	2000	115,191	115,462	118,010	2%

*Percent Difference Calculated Using Alternative 1A and Alternative 2

Figures shown reflect Phase 3 projections and include TSM, BRT, and LRT or Rail.

2025 = Projected data within catchment areas prepared by CTPS

1990 = Actual data within catchment areas based on 1990 U.S. Census.

2000 = Actual data within catchment areas based on U.S. Census.

**Table 6-3
Stations/Stops By Alternative**

	Station Name	City	Mode	Alternative A	Alternative B
Segment 1	Logan Terminals	Boston	BRT	▪	▪
	New Airport Station	Boston	BRT	▪	▪
	Chelsea CRR	Chelsea	BRT/Bus	▪	▪
	Everett Avenue/Mystic Mall	Chelsea	BRT	▪	▪
	Second Street	Everett	BRT	▪	▪
	Santilli Circle/Broadway	Everett	BRT	▪	▪
	Wellington	Medford	BRT	▪	▪
Segment 2				▪	▪
	Assembly Square (LRT)	Somerville	Rail	▪	▪
	Assembly Square (Bus)	Somerville	Bus		▪
	Broadway	Somerville	BRT	▪	▪
	Sullivan Square	Somerville	Rail	▪	▪
	New Washington St	Somerville	Rail		▪
	Washington Street	Somerville	BRT	▪	▪
	Union Square	Somerville	BRT	▪	▪
	Fitchburg Street	Somerville	Rail		▪
	New Lechmere	Cambridge	Rail/BRT/Bus	▪	▪
	First Street/CSG	Cambridge	BRT	▪	▪
	Binney St/Second St	Cambridge	Bus	▪	▪
	Linskey Way	Cambridge	Rail		▪
	Kendall Square	Cambridge	BRT/Bus	▪	▪
	Kendall/MIT (LRT)	Cambridge	Rail	▪	▪
Segment 3	Harvard Station	Cambridge	Bus	▪	▪
	Central Square Station	Cambridge	Bus	▪	▪
	University Park/Lafayette Sq.	Cambridge	Bus	▪	▪
	MIT/Mass Avenue (Bus)	Cambridge	Bus	▪	▪
	MIT/Mass Avenue (LRT)	Cambridge	LRT	▪	▪
	MIT	Cambridge	Bus	▪	▪
	Cambridgeport	Cambridge	BRT	▪	▪
	Amesbury St	Cambridge	Bus	▪	▪
	Allston (Brighton) Landing	Brighton	Bus	▪	▪
		Boston/			
	Packards Corner	Brookline	Bus	▪	▪
	BU Bus		Bus	▪	▪
		Boston/			
	BU Central/CRR	Brookline	Rail		▪
	BU Blanford St		Bus		▪
	Fenway Station	Boston	Bus	▪	

**Table 6-3
Stations/Stops By Alternative (Continued)**

	Station Name	City	Mode	Alternative A	Alternative B
Segment 3 (continued)					
	Kenmore Square	Boston	Bus	■	■
	Hynes/ICA Station	Boston	Bus	■	■
	Boylston/Park St Station	Boston	Rail	■	■
	Brookline Ave	Boston	BRT	■	■
	LMA (bus)	Boston	BRT	■	■
	Longwood Avenue	Boston	BRT	■	■
	Longwood Medical Area	Boston	BRT/Bus	■	■
	Symphony Station	Boston	Bus	■	■
	Green Line E MFA	Boston	BRT/Bus	■	■
	Mass Ave Station	Boston	Bus	■	■
	Ruggles	Boston	Rail/BRT/Bus	■	■
Segment 4					
	Wash. Street/Silver Line	Boston	Bus	■	■
	City Hospital	Boston	BRT/Bus	■	■
	Bio Square	Boston	BRT	■	■
	BU Medical Area	Boston	BRT/Bus	■	■
	Washington St (Roxbury)	Boston	BRT	■	■
	Dudley Square	Boston	Rail/Bus	■	■
	Humboldt (Warren @ Walnut)	Boston	Bus	■	■
	Dudley/Hampden	Boston	Bus	■	■
	Blue Hill Ave	Boston	BRT	■	■
	Southampton Street	Boston	Bus	■	■
	Andrew Station	Boston	Bus	■	■
	UMass Campus	Boston	BRT	■	■
	JFK Umass	Boston	BRT/Bus	■	■
	Edward Everett Square	Boston	BRT	■	■
	Uphams Corner	Boston	BRT/Bus	■	■
	Kane Square	Boston	Bus	■	■
	Fields Corner	Boston	Bus	■	■
	Grove Hall	Boston	Bus	■	■
	Franklin Park	Boston	Bus	■	■
Segment 5					
	Seaport	Boston	BRT	■	■

Table 6-4
Transit-Supportive Regulations Near Transit Stations⁴

Planning and Policy Documents	
Transit Oriented Dev't Study (Boston)	Will categorize transit stops, based on development potential
Roxbury Study (Crosstown/South End)	Will produce an integrated land use and transportation plan
Dudley Square Transp./Air Quality Study	Will examine traffic flow, parking, and the MBTA Silver Line
Brookline Comprehensive Plan	Stresses need to improve transit and reduce auto dependence
Cambridge Growth Policy Document	Argues that transit access should decide scale of development
Cambridge Economic Dev't Policy Highest and Best Use Analysis (Chelsea)	Endorses an Urban Ring transit line
	Calls for moving the Commuter Rail stop to a more useful site
Transit-Supportive Regulations	
Longwood/BU Medical Institutional Plans	Requires institutions to set transit share goals
Brookline Zoning	Allows higher density development near transit stations
Vehicle Trip Reduction (Cambridge)	Expands mobility programs for pedestrians and bicycles
PDTM Ordinance (Cambridge)	Requires businesses to reduce single-occupant vehicle trips
Interim Planning Overlay (Cambridge)	Requires developers to prove no adverse traffic impact
Transit-Oriented Development	
Crosstown Center/Bio-Square	Developments required to incorporate bus waiting facilities
Landmark Center	Had to upgrade Green Line station and pedestrian access
Turnpike Air Rights (BU/Fenway)	Development guidelines call for an Urban Ring transit station
University Park Project (Cambridgeport)	Vehicle trip generation capped at 1,700 peak period trips
Assembly Square	Plans for Orange Line stop to serve new dense development
TeleCom City (Everett)	Plans for shuttle to Orange Line and ferries to Boston/Logan
Shuttle Services	
MASCO	Operates shuttles to MBTA and guaranteed ride home service
Red Sox (Fenway)	Provides remote parking and shuttles from transit stations
Cross Town Shuttle (Somerville)	City-operated express bus, feeds existing MBTA services
Everett	City is developing a shuttle bus service for senior citizens
Chelsea	City is developing a shuttle bus service for senior citizens
Neighborhood Parking Regulations	
Boston Medical Center Master Plan	Upon completion, parking ratio of one space per 1,000 sq. ft.
Longwood Zoning	Parking a conditional use, must be justified by the proponent
Longwood Institutional Master Plan	Total parking ratio to be reduced to one space per 1,000 sq. ft.
Fenway/Turnpike Air Rights	Parking ratio of 0.5 to 0.75 space per 1,000 sq. ft. office space
Logan Airport/East Boston	Parking freeze near airport
Citywide Parking Regulations	
Brookline Traffic Rules and Regulations	Limited long-term on-street parking, and no overnight parking
Brookline Zoning	Parking requirements lowest near transit stations
Cambridge Zoning	Parking requirements lowest near transit stations
Cambridge Resident Sticker Program	Cambridge resident parking only, on residential streets
Somerville Zoning	Parking requirements lowest near transit stations
Everett	Limited parking at meters

⁴ Source: The Compact Report, September 2000 generated by the jurisdictions of Boston, Chelsea, Everett, Somerville, Cambridge, and Brookline.

Table 6-5
Public Programs and Capital Investments⁵

Established Employment Centers	
<i>Boston Medical Center</i> Empowerment Zone	<i>MIT/Massachusetts Avenue</i> Massachusetts Ave. reconstruction and sewer separation
<i>Longwood</i> Huntington Avenue boulevard	
Emerging Employment Areas	
<i>Columbia Point</i> Empowerment Zone Harborwalk	<i>Lechmere/North Point</i> MDC riverfront park New roads in North Point
<i>New Market/South Bay</i> Empowerment Zone Incinerator demolition and cleanup	<i>Union Square/Boylston Yards</i> Economic Opportunity Area Access roadways improvements Brownfield remediation on MBTA property South St./Medford St. reconstruction Installation of fiber optic cable
<i>Crosstown/South End</i> Empowerment Zone Development subsidies and land commitments Request for proposals on Parcels 9/10 New elementary school	<i>Brickbottom/Cobble Hill/Inner Belt</i> Economic Target Area Brownfield site remediation Installation of fiber optic cable
<i>Fenway</i> Public financing for Red Sox stadium Ballpark-area roadway improvements Reconstruction of Fenway and Kenmore Stations Full-time Commuter Rail service at Yawkey Station City commitment to assemble land, build parking	<i>Assembly Square</i> Economic Target Area Vehicle/pedestrian/bicycle access improvements River edge improvements
<i>Cambridgeport</i> Cambridgeport Roadways Project	
Neighborhood Business Centers	
<i>Uphams Corner (New Market)</i> Main Street Project	<i>Cambridge Street (East Cambridge)</i> Cambridge Street reconstruction
<i>Dudley Square (Crosstown)</i> Economic Target Area Economic Opportunity Area Main Street Project Brownfield remediation on Modern Electroplating site Tenant commitment for Ferdinand Building renovation Silver Line and Washington Street reconstruction	

⁵ Source: The Compact Report, September 2000 by Boston, Chelsea, Everett, Somerville, Cambridge, and Brookline

Table 6-6
New Developments and Renovations

Established Employment Centers	
<i>Boston Medical Center</i>	<i>MIT/Massachusetts Ave.</i>
Boston University Medical Center research/care facilities	MIT Stata Center
Bio-Square	
<i>Longwood</i>	<i>Kendall/East Cambridge</i>
Children's Hospital clinical/research centers	Nearly 1 million sq. ft. of office/R&D built since 1990
Harvard Institutes of Medicine 2 nd phase	Renovation of several old industrial sites
Emmanuel College's Merk research center	<i>Logan Airport</i>
Academic institutions' development plans	Logan International Airport expansion
Emerging Employment Areas	
<i>Columbia Point</i>	<i>Cambridgeport</i>
Doubletree hotel	University Park
Office building on Morrissey Boulevard	
<i>New Market/South Bay</i>	<i>Lechmere/North Point</i>
South Bay Mall expansion	CambridgeSide Galleria
Super 88 supermarket	Several housing and office projects
Proposed office buildings	MBTA/Guilford development
Best Western hotel	
<i>Crosstown/South End</i>	<i>Brickbottom/Cobble Hill/Inner Belt</i>
Crosstown Center	Telecom hub in former Filene's Basement warehouse
Renaissance Center	Two-building office/telecommunications center
<i>Fenway</i>	<i>Rutherford Avenue/Sullivan Square</i>
Landmark Center	Hood Business Park
Red Sox stadium	
Residential Growth	
<i>Boston</i>	<i>Cambridge</i>
1,850 housing units permitted in 1999 alone	Near 1,500 units, 300 affordable, since 1990
Orchard Park/Mission Main redevelopment	University Park (Cambridgeport)
Northeastern Univ. market/low-income units	Museum Towers and future North Point development
Northeastern/Boston Univ. dormitories	MIT dormitories and faculty housing
Landmark housing (Fenway)	
Elderly housing near Symphony Towers (Fenway)	<i>Everett</i>
Clipper Ship Wharf (East Boston)	Cooperative Services senior housing
	Apartment building renovation by Caritas
Neighborhood Business Centers	
<i>Uphams Corner (New Market)</i>	<i>Downtown Chelsea</i>
Uphams Corner Marketplace	Massachusetts Information Technology Center
Community health center	Bunker Hill Community College campus
	Courthouse
<i>Dudley Square (Crosstown)</i>	<i>Everett Square</i>
Office/retail development on Modern Electroplating site	US Post Office
Palladio Hall	
Ferdinand Building	
Roxbury Boys and Girls Club building	
One Palmer Street	
Harrison Supply	
Storefront improvements	

Table 6-7
Employment in Catchment Areas, 1995 and 2025

		Alternative A1	Alternative A2	Alternative B
Segment 1	1995	11,247	11,818	11,247
	2025	16,299	18,253	16,299
	Net Change	5,052	6,435	5,052
	% Change	44.9%	54.5%	44.9%
Segment 2	1995	33,897	39,897	46,715
	2025	62,970	62,970	72,766
	Net Change	23,073	23,073	26,051
	% Change	57.8%	57.8%	55.8%
Segment 3	1995	117,528	117,528	115,259
	2025	148,959	148,959	144,295
	Net Change	31,431	31,431	29,036
	% Change	26.7%	26.7%	25.2%
Segment 4	1995	32,470	32,407	32,407
	2025	39,930	39,930	39,930
	Net Change	7,523	7,523	7,523
	% Change	19.3%	23.2%	23.2%
Segment 5	1995	9,593	9,593	9,593
	2025	43,094	43,094	43,094
	Net Change	33,501	33,501	33,501
	% Change	349.2%	349.2%	349.2%
Total	1995	210,672	211,243	215,221
	2025	311,252	313,203	316,384
	Net Change	100,580	101,963	101,163
	% Change	47.7%	48.3%	47.0%

Table 6-8
Residential Population Within Catchment Areas, 1995 and 2025

		Alternative A1	Alternative A2	Alternative B
Segment 1	1995	14,942	15,941	14,942
	2025	18,106	19,263	18,106
	Net Change	3,164	3,322	3,164
	% Change	21.2%	20.8%	21.2%
Segment 2	1995	30,145	30,145	37,688
	2025	33,621	33,621	41,372
	Net Change	3,476	3,476	3,684
	% Change	11.5%	11.5%	9.8%
Segment 3	1995	97,196	97,196	99,395
	2025	112,980	112,980	113,789
	Net Change	15,784	15,784	14,394
	% Change	16.2%	16.2%	14.5%
Segment 4	1995	66,393	66,393	66,393
	2025	75,417	75,417	75,417
	Net Change	9,024	9,024	9,024
	% Change	13.6%	13.6%	13.6%
Segment 5	1995	182	182	182
	2025	2,257	2,257	2,257
	Net Change	2,075	2,075	2,075
	% Change	1,140.1%	1,140.1%	1,140.1%
Total	1995	208,858	209,857	218,600
	2025	242,381	243,538	250,941
	Net Change	33,523	33,681	32,341
	% Change	16.1%	16.0%	14.8%

Table 6-9
Households Within Catchment Areas, 1995 and 2025

		Alternative A1	Alternative A2	Alternative B
Segment 1	1995	5,883	6,314	5,883
	2025	7,573	8,124	7,573
	Net Change	1,690	1,810	1,690
	% Change	28.7%	28.7%	28.7%
Segment 2	1995	12,151	12,151	14,908
	2025	14,556	14,556	17,632
	Net Change	2,405	2,405	2,724
	% Change	19.8%	19.8%	18.3%
Segment 3	1995	36,828	36,828	38,497
	2025	44,896	44,896	45,272
	Net Change	8,068	8,068	6,775
	% Change	21.9%	21.9%	17.6%
Segment 4	1995	24,367	24,367	24,367
	2025	28,090	28,090	28,090
	Net Change	3,723	3,723	3,723
	% Change	15.3	15.3%	15.3%
Segment 5	1995	91	91	91
	2025	1,143	1,143	1,143
	Net Change	1,052	1,052	1,052
	% Change	1,156.0%	1,156.0%	1,156.0%
Total	1995	79,320	79,751	83,746
	2025	96,258	96,944	99,710
	Net Change	16,938	17,193	15,964
	% Change	21.4%	21.6%	19.1%

Table 6-10
Households with No Vehicles, 1990

		Alternative A1	Alternative A2	Alternative B
Segment 1	Households w/ 0 vehicles	2,170	2,228	2,170
	Percent w/ 0 vehicles	36.8%	35.3%	36.8%
Segment 2	Households w/ 0 vehicles	3,584	3,584	4,478
	Percent w/ 0 vehicles	29.6%	29.6%	30.3%
Segment 3	Households w/ 0 vehicles	17,929	17,929	17,476
	Percent w/o vehicles	46.9%	46.9%	45.8%
Segment 4	Households w/ 0 vehicles	11,603	11,603	11,603
	Percent w/o vehicles	47.9%	47.9%	47.9%
Segment 5	Households w/ 0 vehicles	28	28	28
	Percent w/o vehicles	26.7%	26.7%	26.7%
Total	Households w/ 0 vehicles	35,314	35,372	35,755
	Percent w/ 0 vehicles	43.8%	43.6%	42.7%

Table 6-11
Households Below Poverty, 1990

		Alternative A1	Alternative A2	Alternative B
Segment 1	Households below Poverty	1,135	1,166	1,135
	Percent below Poverty	19.3%	18.5%	19.3%
Segment 2	Households below Poverty	1,393	1,393	1,805
	Percent below Poverty	11.5%	11.5%	12.2%
Segment 3	Households below Poverty	8,469	8,469	8,269
	Percent below Poverty	22.1%	22.1%	21.7%
Segment 4	Households below Poverty	6,189	6,189	6,189
	Percent below Poverty	25.5%	25.5%	25.5%
Segment 5	Households below Poverty	18	18	18
	Percent below Poverty	17.1%	17.1%	17.1%
Total	Households below Poverty	17,204	17,235	17,416
	Percent below Poverty	21.3%	21.1%	20.8%

Table 6-12
Minority Population, 2000

		Alternative A1	Alternative A2	Alternative B
Segment 1	Minority Population	9,615	9,819	9,615
	Percent Minority Population	54.9%	53.1%	54.9%
Segment 2	Minority Population	10,900	10,900	14,271
	Percent Minority Population	34.2%	34.2%	36.1%
Segment 3	Minority Population	33,813	33,888	33,259
	Percent Minority Population	36.9%	36.8%	36.3%
Segment 4	Minority Population	60,788	60,788	60,788
	Percent Minority Population	73.0%	73.0%	73.0%
Segment 5	Minority Population	77	77	77
	Percent Minority Population	26.5%	26.5%	26.5%
Total	Minority Population	115,191	115,462	118,010
	Percent Minority Population	52.0%	51.9%	51.6%

Figure 6-1
Urban Ring Analysis Segments

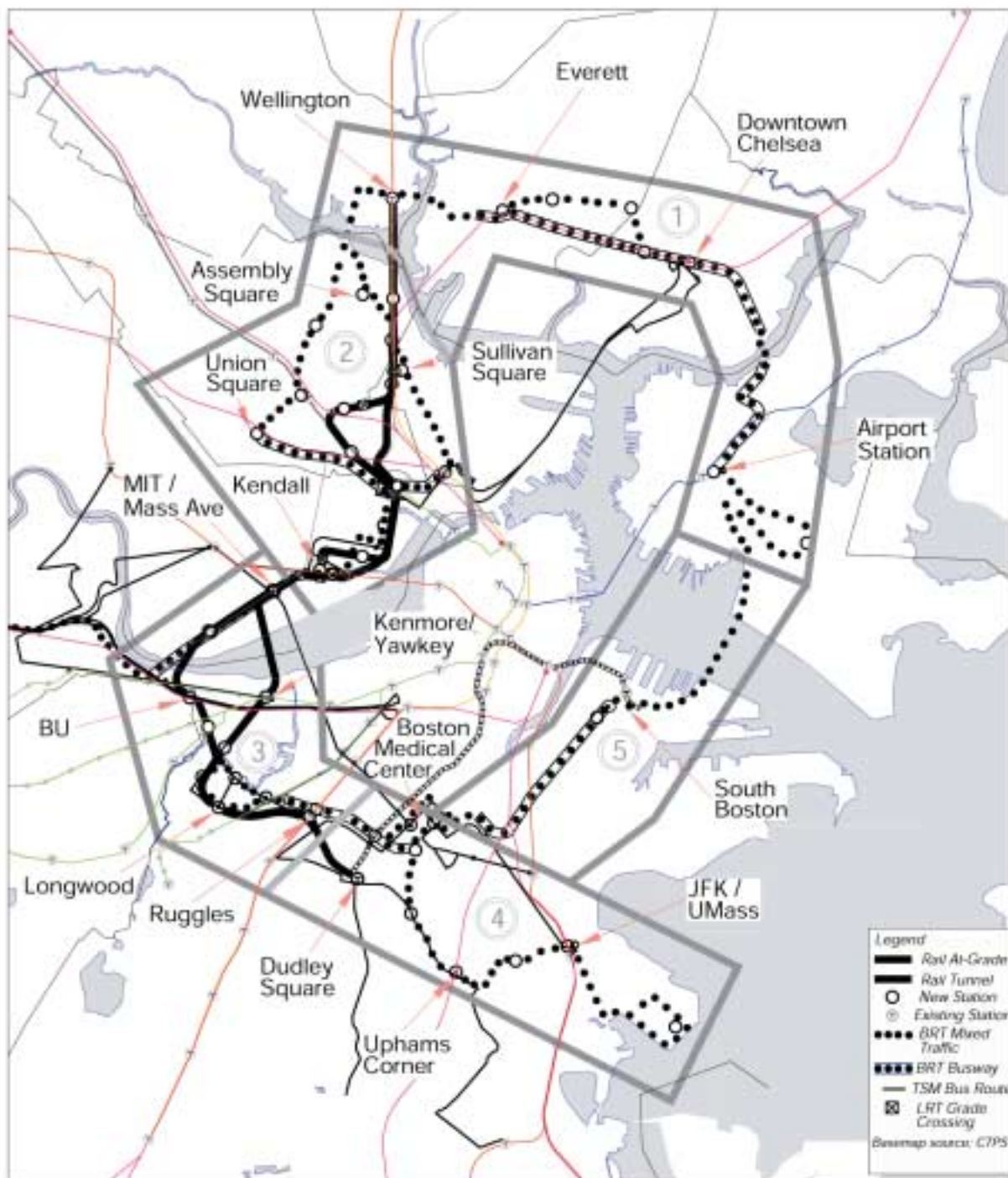


Figure 6-2
Catchment Areas for Alternative A1

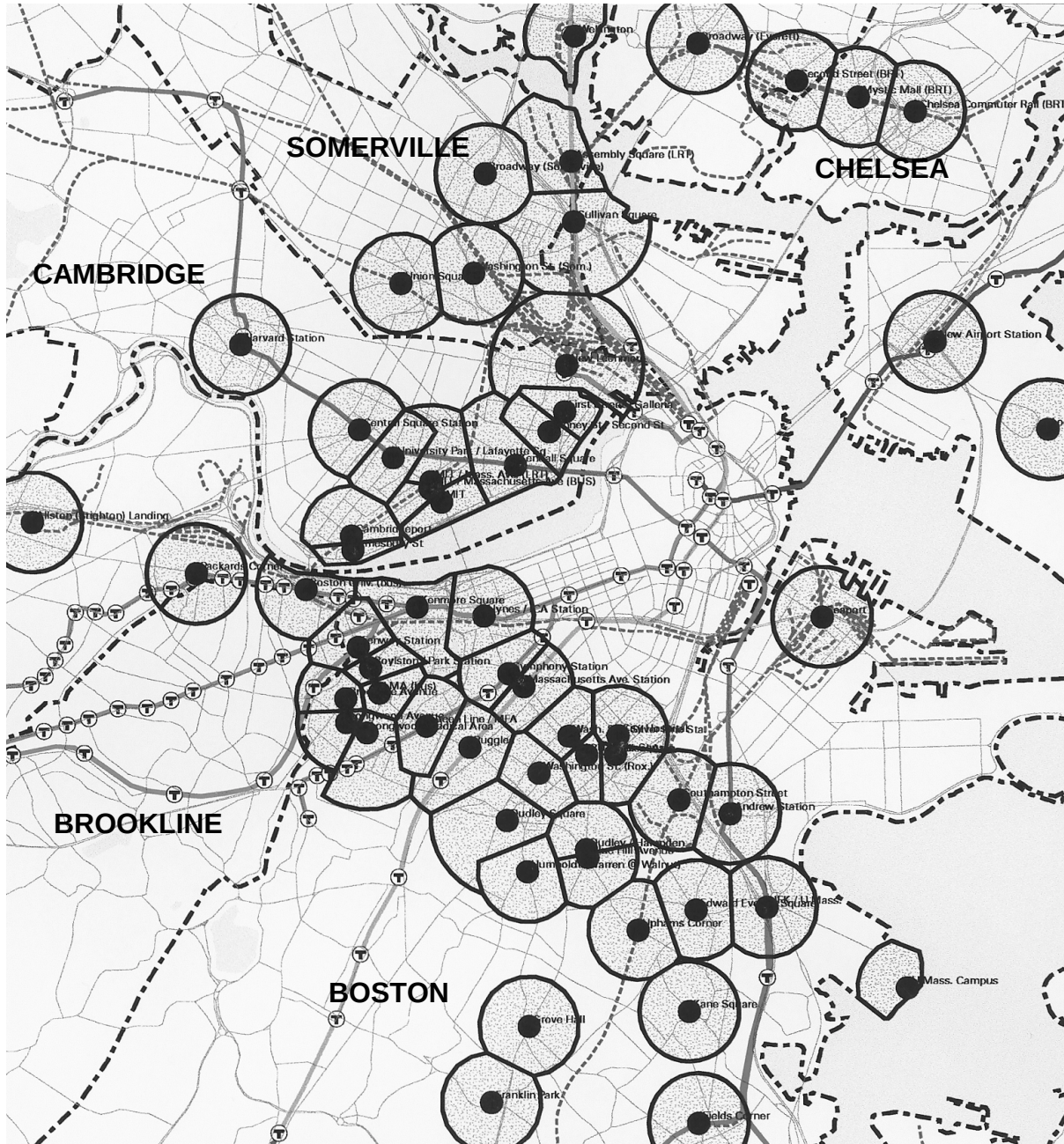


Figure 6-3
Catchment Areas for Alternative A2

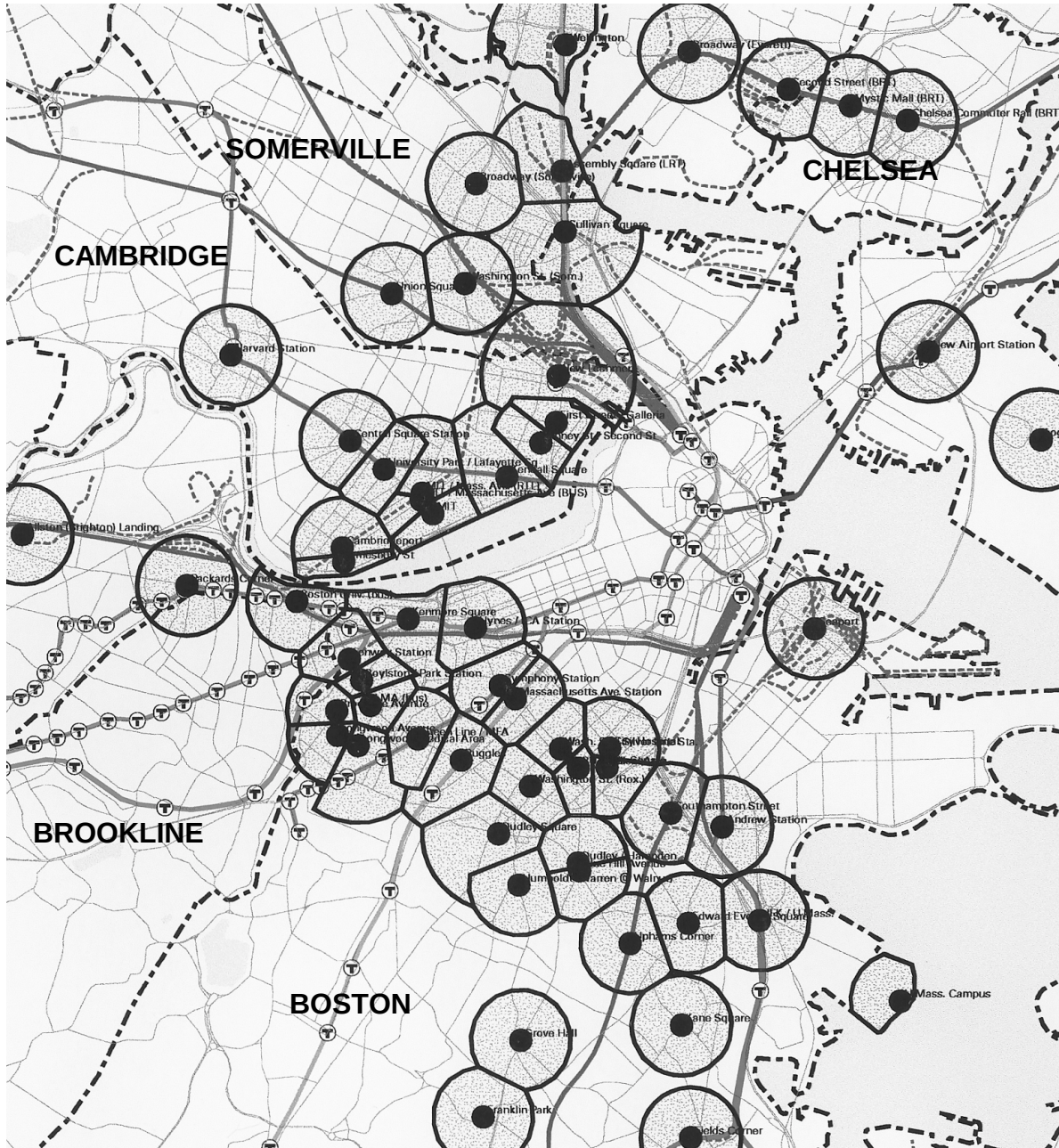


Figure 6-4
Catchment Areas for Alternative B

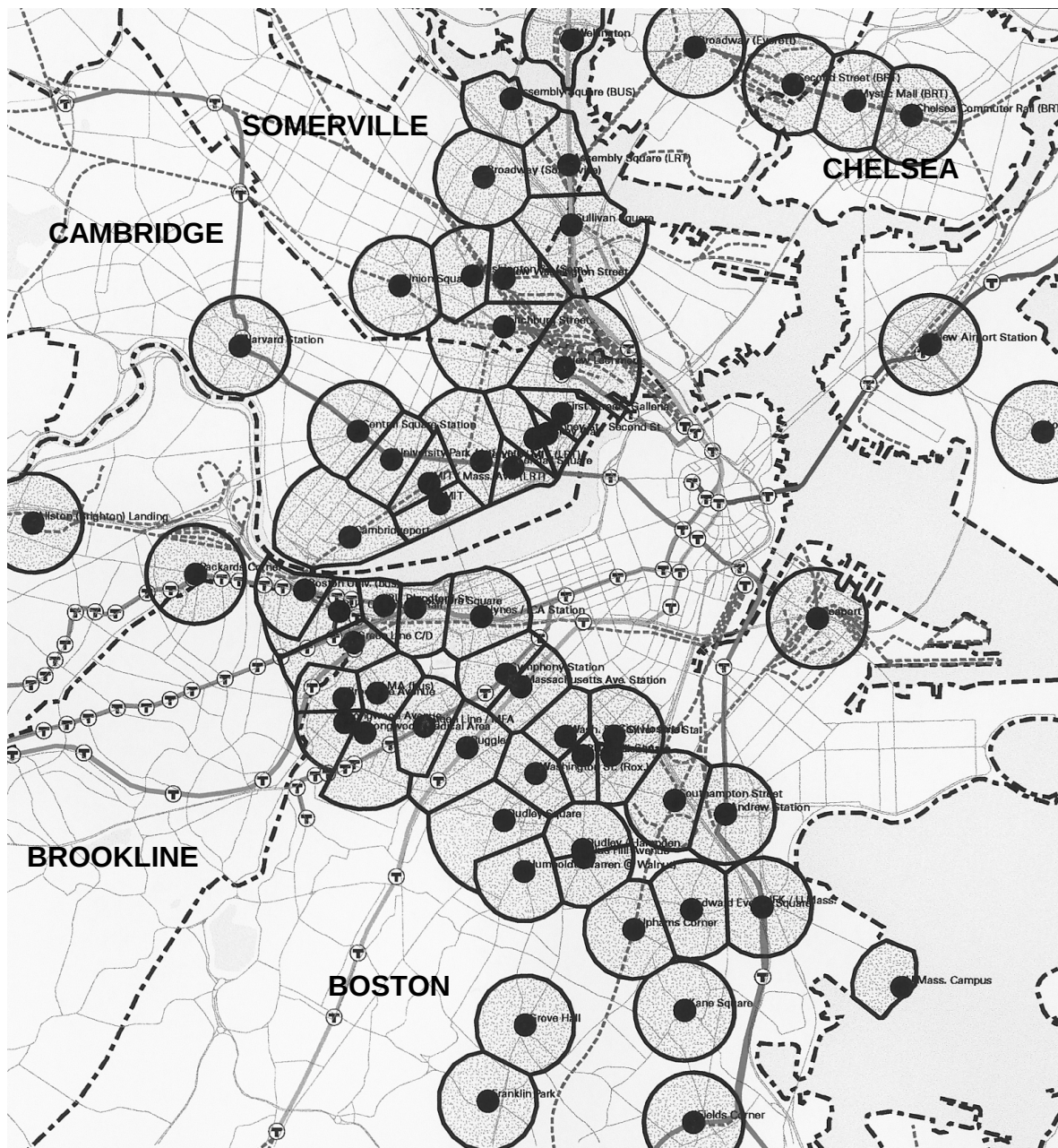
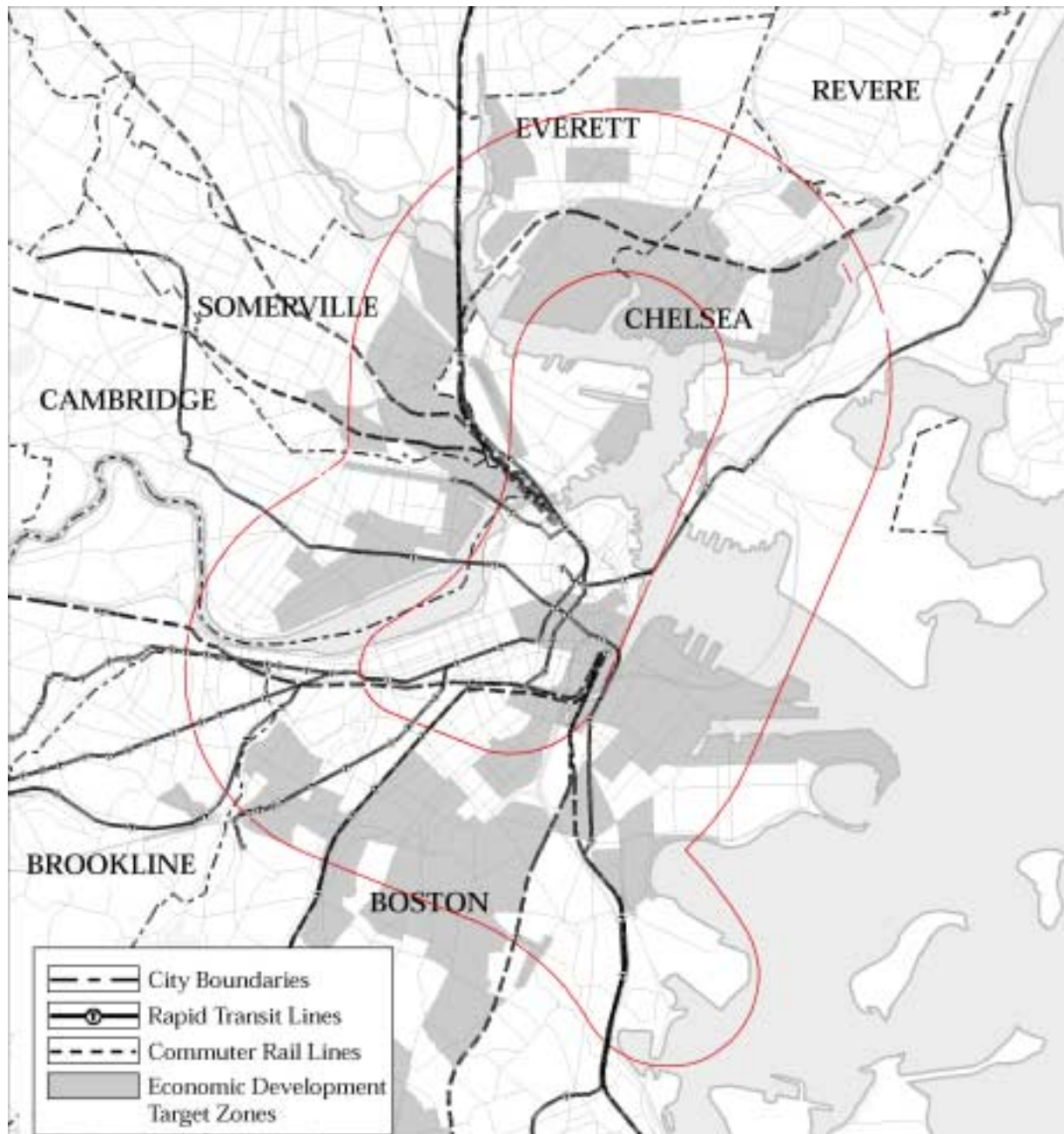


Figure 6-5
Economic Development Target Zones



Chapter 7

CAPITAL, OPERATING AND MAINTENANCE COSTS

7.0 CAPITAL, OPERATING AND MAINTENANCE COSTS

This chapter provides magnitude estimates of the capital cost of the Urban Ring final alternatives, as well as magnitude estimates of the annual operating and maintenance costs of those alternatives in Phase 1, 2, and 3. The capital cost estimates shown are in 2001 constant dollars exclusive of debt service. Additionally, the chapter summarizes the status of the Urban Ring financial analysis.

7.1 Capital Costs

7.1.1 Introduction

The following sections include:

- Methodology
- Summary of capital costs
- Geographic breakdown
- Details by alternative
- Unit price development

7.1.2 Methodology

Plan and profile drawings of the final alternatives and their associated typical sections formed the basis for development of the direct construction components. System-wide elements used a combination of alternative-specific quantity estimates applied to typical system-wide unit costs for major capital items such as rolling stock. Costs for impacts and mitigation, and right-of-way acquisition were developed based on allowances and/or percentages based on mileage, and comprise a relatively minor portion of the total capital costs.

A contingency of 50 percent for direct construction, mitigation and right-of-way acquisition was added to each group of cost components. Costs were then added for design, administration and construction management to reach the total costs for each phase and alternative. The capital costs shown are in 2001 constant dollars, exclusive of any debt service.

7.1.2.1 Direct Construction

Using a combination of existing MBTA design standards and other transit industry standards where necessary, an alignment was developed at a scale of 1"=200' for the Phase 2 BRT system and supporting elements. For Alternatives A1, A2, and B in Phase 3, which are primarily in tunnel, conceptual profiles were also developed in addition to the alignment plans. The alignment was developed using aerial basemaps coupled with limited field inspection along a densely developed corridor approximately 15 miles long. Subsurface conditions are generally unknown because no geotechnical work was performed. Some field measurements and general right-of-way research was done at a limited number of locations.

Using MBTA and other standards in tandem with the general alignment and profile requirements of each alternative, a companion set of typical sections was also developed. Unit prices were developed for each of the typical sections.

The typical sections depict, on a generic basis, the type of construction anticipated at and between each station in each of the alternatives. There are one or more typical sections for each technology (Light Rail Transit, Heavy Rail Transit and Bus Rapid Transit), as well as the different profiles (tunnel, at-grade and viaduct) and type of station (at-grade, underground cut and cover, and underground deep mined). Quantity takeoffs were then performed for each alternative and the quantities then applied to the unit prices of the relevant typical section.

7.1.2.2 System-Wide Elements

Rolling Stock, maintenance facilities, and signals and communication are considered system-wide elements. System-wide elements are typically installed or added to the facility after much of the direct construction elements have been completed, except in the case of the maintenance facility, which can be constructed at the same time as the track and structures.

For rolling stock, the operating statistics provided by CTPS were the basis for determining the necessary fleet size of the vehicles needed for each alternative. The MBTA's per vehicle cost for new low-floor Green Line vehicles was used as the basis for the Urban Ring LRT vehicle unit costs. The MBTA also provided costs for Orange Line vehicles that were used as the basis for the Urban Ring rapid transit alternative. The purchase price for Bus Rapid Transit vehicles is based on the purchase price of 60' articulated CNG low-floor buses that the MBTA is in the process of obtaining for the Silver Line. The price of the 40' long, low-floor, CNG buses used for Phase 1 of the Urban Ring are based on the bus prices associated with the MBTA's current order for CNG buses that will be replacing its current fleet of diesel buses on existing routes.

In the category of signals and control bungalows the costs shown in Phase 2 represent an allowance to modify and upgrade signal systems at intersections along the BRT route for signal priority, and for related ITS features for the BRT routes. In Phase 3, these costs are for the rail system.

Phase 1, 2, and 3 each require some modification or expansion of vehicle maintenance facilities for the associated rolling stock. The costs shown are allowances based on the comparative requirements of each phase and, in Phase 3, the type of rail vehicle used. The allowance shown for the Alternative A2 maintenance facility consists of expanding the existing Wellington heavy rail maintenance facility. Expanding this existing facility can be expected to cost significantly less than siting and building the new LRT maintenance facility associated with Alternatives A1 and B.

7.1.2.3 Impacts and Mitigation

All Urban Ring alternatives would involve construction of new transportation facilities and involve new transit operations with associated potential environmental impacts. The impacts and mitigation for construction and operations would vary depending upon the alternative chosen, particularly with regard to whether the alignment is at-grade or underground, and whether the technology is Light Rail Transit, Bus Rapid Transit or a combination of these technologies.

The capital costs associated with impact mitigation were broken into the categories of wetlands, noise and vibration, and hazardous materials.

Potential wetland impacts during Phase 2 busway construction are located in Chelsea along the abandoned freight rail right-of-way between Chelsea Creek and the commuter rail line in downtown Chelsea, and an area west of Route 99 and south of Santilli Circle in Everett. An allowance is included to mitigate possible impacts. A smaller allowance is included for Phase 3 wetlands mitigation because the rail routes do not pass through these areas and are mostly underground. The location and extent of possible wetland impacts and replication costs will be determined during the environmental process. Meanwhile, allowances for wetland replication are included in the capital cost estimate.

The need for noise and vibration mitigation and electromagnetic field (EMF) mitigation during operations is concentrated where the Phase 3 rail alignments passes through the MIT campus and the Longwood Medical Area potentially impacting adjacent laboratories. The approximate linear footage of the alignment adjacent to such facilities was estimated from the alignment drawings and an allowance applied to the quantity. As discussed in Chapter 5, Alternative B would have the greatest potential for such impacts and thus has a higher cost allowance for mitigation. There is no cost allowance for EMF or noise and vibration mitigation in Phase 1 or Phase 2 because the CNG powered vehicles would not generate EMF and the noise and vibration impacts are expected to be minimal. The specific mitigation requirements and costs associated with the alternatives will be determined during the environmental process.

Potential hazardous materials mitigation during construction was estimated by first identifying the number of known release sites within 500' of the alignment of each of the alternatives defined earlier in the study, using the New England DataMap Technology Corporation Environmental First Search database as of March 1997. The Phase 2 BRT alternative and the Phase 3 rail alternatives each would pass within 500' of a large number of such sites. Alternatives A1 and A2 would be in deep tunnel below most sites whereas Alternative B, which is mostly at-grade and in shallow tunnel through Somerville and East Cambridge, has a greater potential for encountering such sites. An allowance was applied to each of the sites to provide a conservative cost for mitigation. The specific mitigation requirements and costs associated with the alternatives will be determined during the environmental process.

7.1.2.4 Right-of-Way Acquisition

Right-of-way acquisition was estimated for portions of a-grade alignments not currently owned by the MBTA, and for land needed for maintenance facilities for the LRT and Bus Rapid Transit systems. It was assumed that any minor right-of-way acquisition necessary for underground alignments and stations for such things as station headhouses and vent structures would be relatively minor and covered within the construction cost contingency.

Areas of the alignment requiring right-of-way acquisition include the abandoned Conrail (now CSX) line in Chelsea between downtown Chelsea and Chelsea Creek, which is needed for the Bus Rapid Transit line in each of the three alternatives. Additionally, the active Guilford freight storage tracks adjacent to Sullivan Square and New Washington Street in Somerville and Charlestown would need to be acquired for implementation of Alternatives A1, A2, or B. Right-of-way acquisition unit costs from the MBTA's Ipswich-Newburyport commuter rail extension were escalated and applied to quantity takeoffs from the Urban Ring alignment drawings to estimate the right-of-way costs. Finally, an allowance was assumed for land acquisition adjacent to the Boston Engine Terminal for the new LRT heavy maintenance facility associated with Alternatives A1 and B. A significantly smaller allowance was included in Alternative A2 for an expansion of the existing Wellington heavy rail maintenance facility. An allowance was also included for land acquisition in the northern portion of the Corridor for a Bus Rapid Transit vehicle maintenance facility at a location yet to be determined.

7.1.3 Summary of Capital Costs

All costs are expressed in 2001 constant dollars exclusive of debt service. The magnitude capital costs of the alternatives with a 50 percent contingency on construction and including design and construction management, administration and insurance are shown in Table 7-1 and summarized below¹. The capital costs shown for each phase are additive to the previous phase as shown in the cumulative column below. The Phase 1 and Phase 2 costs are common to each of the Phase 3 alternatives. All capital costs shown are exclusive of debt service.

	<u>Phase</u>	<u>Cumulative</u>
Phase 1:	\$100 million	\$100 million
Phase 2:	\$500 million	\$600 million
Phase 3A1:	\$2.3 billion	\$2.9 billion
Phase 3A2:	\$2.2 billion	\$2.8 billion
Phase 3B:	\$2.2 billion	\$2.9 billion

¹ Figures shown are rounded from Table 7-1.

7.2 Operating and Maintenance Costs

7.2.1 Methodology

The annual Operation and Maintenance (O&M) costs of the proposed Urban Ring services were estimated using the following process:

- Urban Ring services by phase and alternative were provided to CTPS for coding;
- CTPS model projected daily Urban Ring operating statistics by phase and alternative using vehicle capacities and train sizes consistent with Regional Transportation Plan;
- Daily operating statistics were annualized using formula based on days/hours of service;
- The annualized statistics were applied to the MBTA operating expense factors as documented in the 1998 National Transit Database for each Urban Ring transit mode.
- In the absence of MBTA operating cost data for BRT in the 1998 Database, conventional bus costs were increased by 30% due to the lower reliability and higher fuel costs of the BRT vehicles.

All costs shown are in 2001 dollars. The O&M cost methodology assumes continuation of the present train crew size requirements and fare collection system which are reflected in the cost factors contained in the 1998 National Transit Database. Future changes in fare collection, such as a proof of payment system, and/or changes in crew size prior to implementation of Urban Ring Phase 3 could result in a lower O&M cost basis for rail compared to those projected herein. According to the 1998 Database, salaries, wages and benefits comprise 73% of total operating expenses and will continue to be the largest determinant of future O&M costs.

The details of this process are described below and the results are summarized in the accompanying tables.

7.2.2 Performance Measures

The operating costs were initially calculated for each of the four cost factors drawn from performance measures that are grouped into two categories: Service Efficiency (Costs per Vehicle Revenue Mile and Costs per Vehicle Revenue Hour), and Cost Effectiveness (Costs per Passenger Mile and Costs per Unlinked Passenger Trip). For purposes of this study it was assumed that the Service Efficiency factors would be used in this analysis.

Table 7-2 represents values taken from the Performance Measures section of the 1998 National Transit Database for the MBTA. This table shows both service efficiency and cost effectiveness values for analysis and discussion. We are assuming an increase of 30% for the Bus Rapid Transit (BRT) mode over the Motor Bus (Bus) mode. The rationale is that a 60' articulated BRT vehicle has lower reliability and availability compared to a conventional 40' diesel bus. From Table 7-2, it can be seen that Light Rail is the most expensive mode in both costs per vehicle revenue mile and per vehicle revenue hour by a large margin. It should be noted that the costs shown in the National Transit Database reflect each car of 2-car Green Line LRT trains being run currently, yet in the Urban Ring service, it is assumed that the LRT will operate in 3-car trains, which should reduce costs. The Bus mode is the least expensive in both costs per vehicle revenue mile and per vehicle revenue hour, with the heavy rail being between the two for both items.

Table 7-2 also displays the cost effectiveness values for all the modes. For the cost per passenger mile, the bus mode is the highest, followed closely by light rail and the heavy rail has the lowest cost. The cost

per unlinked passenger trip is highest for the bus mode at \$1.69, followed by heavy rail, with light rail having the lowest unlinked passenger trip cost. As mentioned above, for purposes of the MIS the service efficiency factors were used for estimation of the O&M costs for the Urban Ring alternatives.

7.2.3 Service Efficiency

Table 7-3 displays the service efficiency (vehicle hours and vehicle miles) costs broken down by mode, phase and alternatives. Since Phase 1 consists of modifications to the current bus system, the operation and maintenance costs are reflected only in motor bus. Using the values from Table 7-2 for the bus mode, the annual vehicle hour cost is higher than the annual vehicle miles cost. In Phase 2, Bus Rapid Transit (BRT) is added, reducing service on regular buses (motor bus). Review of available technical reports indicates the O&M costs will be higher. For purposes of this analysis, we have assumed BRT vehicle hour and vehicle mile costs to be 30% higher than the conventional bus costs shown in the 1998 National Transit Database.

In Phase 3, rail service is added onto Phase 2, with two different rail options. Of the three alternatives, the least costly, in both total vehicle hour and total vehicle mile costs, is alternative A2, which uses Orange Line Technology (Heavy Rail). The costs for all three alternatives for the BRT is the same, while the vehicle hour costs and vehicle miles costs for motor bus are less in Alternative B.

Although they follow virtually the same mainline route, the O&M costs of Alternative A1 are more than Alternative A2 primarily because the costs per revenue hour and revenue mile are higher for Light Rail than they are for Heavy Rail. The annual vehicle hour cost in Alternative A2 is slightly less than the cost for A1 and is much less for the annual vehicle miles cost. Two other reasons that the A1 costs are higher than A2 are: The A1 rail vehicle miles and vehicle hours include the overlapping LRT route that serves the Green Line Extension; and the total trains per hour are slightly less with A2 (15 trains/hour in peak period) than with A1 (18 trains/hour in peak period).

Alternatives A1 and B both use Light Rail Transit (LRT) and contain the same overlapping LRT route serving the Green Line Extension. However, the mainline of Alternative B follows a longer route through Somerville and Cambridge resulting in higher vehicle miles and hours compared to Alternative A1. Alternative A2, in both total vehicle hours and total vehicle miles, is much less expensive than either Alternative A1 or B. The O&M costs for Alternative A1 are higher than for Alternative B because of the larger number of bus hours and miles, which offset the higher Light Rail Transit costs for Alternative B. Table 7-4 shows the weekday operating statistics in vehicle miles and vehicle hours for each phase and alternative, and Table 7-5 converts the weekday figures into annual statistics for purposes of estimating the annual O&M costs.

7.2.4 Summary of O&M Costs

Operating statistics for the final alternatives were prepared by the Central Transportation Planning Staff (CTPS) in May 2001. An estimate of the number of days that each transit mode will operate in the Urban Ring in a standard year was taken from the MBTA's 1998 National Transit Database along with the cost per vehicle hour factor for each transit mode. The total annual operating costs of the Alternatives at the full implementation of each Phase are shown below in Year 2001 constant dollars. For Phase 2 and 3 a breakdown of the O&M cost by mode is shown in parentheses.

Phase 1:	\$23 million/yr.
Phase 2:	\$31 million/yr. (\$10.5M bus + \$20.5M BRT = \$31M)
Phase 3A1:	\$56 million/yr. (\$14M bus + \$19M BRT + \$23M LRT = \$56M)
Phase 3A2:	\$55 million/yr. (\$14M bus + \$19M BRT + \$22M Heavy Rail = \$55M)

Phase 3B: \$56 million/yr. (\$12M bus + \$19M BRT + \$25M LRT = \$56M)

Due to the significant capital, operating, maintenance, and debt service costs associated with the Final Alternatives, as well as the competitive environment for federal and state funding, the MIS has begun to examine a wide range of innovative funding concepts for possible application to the Urban Ring. The examination of innovative funding mechanisms for Phases 2 and 3 will continue following the MIS Final Report. Cost effectiveness indices for each of the phases will be determined during the DEIR/DEIS process, using the new Federal Transit Administration formulas that are expected to become available

7.3 Financing Options

7.3.1 Current Sources of Funding

The MBTA receives operating and capital revenue to fund its existing system and new projects from a number of sources. Operating revenue comes from four major sources:

- Farebox;
- Other revenue from advertising, parking, concession, real estate sales, etc.;
- Federal operating assistance; and
- Local assessments.

Capital funds are derived primarily from MBTA revenue bonds and Federal capital grants, including formula-based Section 5307 funds and discretionary Section 5309 ("New Starts") grants. The MBTA has received Section 5309 funds for other major capital investment projects, including the first phase of the Silver Line connecting South Station to the South Boston Waterfront area. FTA's Section 5309 program is highly competitive nationwide, and involves an application process in which the project must be justified based on forecasted mobility, environmental, operating efficiencies, cost effectiveness, and land use impacts, as well as the adequacy of the project's financing plan.

It should be noted that the New Starts criteria have recently been revised by FTA, per the Major Capital Investment Projects Final Rule, which took effect February 5, 2001. FTA is in the process of providing new guidance on the application of these revised criteria. Most significantly, the methodology for calculating cost effectiveness has undergone a major revision. FTA is finalizing software needed to support the cost effectiveness calculation, and it is anticipated that the MBTA will be among the first transit agencies nationwide to receive this software. In addition, FTA will establish new rating thresholds for cost effectiveness. These new thresholds are anticipated by the fall of 2001. The MBTA has substantial experience working with FTA on the preparation of New Starts applications, and expects that once the project has been defined for Phase 2 and Phase 3 a New Starts application process will be initiated with FTA.

In addition, the Urban Ring has significant potential to expand the economic base of the communities that it will serve. Options for innovative financing built on this expanded economic base, including joint development, have been reviewed and will be examined in further detail as the project advances. These options will then be incorporated, as feasible, into the financing plan for the preferred alternative. Incorporation of innovative financing features in the project financing plan will help increase the likelihood that the project will receive a discretionary Section 5309 grant from FTA, which seeks to encourage such financial innovation.

7.3.2 Potential Future Sources of Funding

To date, the MIS has begun to examine hypothetical revenue streams from a range of possible innovative funding strategies for the Urban Ring project. These strategies rely on local, public sector and state sources and were chosen for further consideration, in consultation with the Financing Options Subcommittee and the MBTA, from a range of possible strategies originally identified in the 1998 Innovative Funding Techniques technical memorandum. Three levels of innovation have been examined to-date: a conventional strategy, a more innovative strategy and a very aggressive strategy. Table 7-6 summarizes the levels of innovation and the strategies contained in each.

Another issue, which must be addressed in a subsequent phase of the MIS project, is the specific mechanism(s) that will be applied in each case to collect and channel these revenues into the project funding stream. Given the unorthodox nature of the strategies, such mechanisms are assumed to not currently be in place.

The potential future strategies are listed in general order from conventional to innovative; with the most aggressive listed at the end of this section. Conventional funding mechanisms are those currently utilized in Massachusetts. These mechanisms require no legislative action. The more innovative strategies would use one or more mechanisms not currently in use within Massachusetts. Some legislative action would be required for the innovative strategies. Finally, the aggressive strategies would rely primarily on mechanisms not currently in use in Massachusetts. Some of these mechanisms have track records elsewhere and some may be precedent setting nationally. The aggressive strategies would likely require significant new legislation at the state and/or municipal level.

° **Increase MBTA Assessment**

The MBTA assessment to the Compact communities would be increased reflecting the quality of improved transit service that the Urban Ring will provide these communities. An increase in assessment would be applied to other communities within the MBTA district reflecting the overall improvement in regional transit services provided by the Urban Ring. This strategy is assumed to generate revenues on an annual basis. (It should be noted, however, that the MBTA assessment is currently set at the maximum allowable under existing legislation and that any increase in the assessment for use by the Urban Ring or any other MBTA project would require a Proposition 2½ override.)

° **Payment in Lieu of Taxes (PILOT)**

Two strategies were discussed as a means of deriving revenue from tax exempt institutions benefiting from improved access provided by the Urban Ring – a Student Fee assessed to institutions of higher learning and an Outpatient Fee assessed to hospitals. Discussions with the Finance Options Subcommittee concluded that these mechanisms could essentially be encompassed through the existing mechanism of Payments in Lieu of Taxes or PILOT. This program is currently utilized in both the cities of Cambridge and Boston as a means of generating revenue to support city services provided to institutions that might otherwise be exempt from property taxes. In Boston, this is defined as “a voluntary annual payment” from a tax-exempt organization contemplating expansion or improvement to its property.² The PILOT is intended to focus on the expansion and replacement of tax-exempt property, rather than seeking payments on existing facilities. PILOT payments are based upon the value of the property and the revenue the municipal government forgoes due to the exempt status of the property.

Given the case specific nature of the PILOT program, no calculation can be made at this time of the potential contribution such a program might make to the Urban Ring. Regardless, it could potentially provide an on-going source of revenue to support both capital and operating expenses. One issue that would need to be addressed, however, is the means by which the municipality collecting the PILOT revenue would channel the funds to the MBTA or the Commonwealth.

² City of Boston, Payment in Lieu of Tax Program, Guidelines for Tax-Exempt Institutions, May 1997.

◦ **Linkage Payments**

An additional source of revenue identified in discussions with the Finance Options Subcommittee is Linkage Payments. In this case, fees are assessed by municipalities for certain types of development to support provision of municipal services and/or construction of municipal facilities. In the City of Boston, linkage payments are negotiated for certain type of large projects, planned development areas (PDA), and institutional developments. Linkage payments are contributed toward the development of low and moderate income housing in the amount of \$5 per square foot and for jobs creation in the amount of \$1 per square foot applied to qualifying projects in excess of 100,000 square feet gross floor area. In the City of Cambridge, a linkage payment fee of \$4 per square foot is assessed for non-residential development of 50,000 square feet or greater (no fee is applied to the first 50,000 square feet). These payments are then deposited in an affordable housing trust fund. Such a mechanism applied to the Urban Ring would potentially generate revenue on a one-time basis through major developments within the Urban Ring catchment areas. As in the case of the PILOT program discussed above, the case specific nature of a linkage program prevents the quantification of the potential revenues resulting from such a program.

◦ **Joint Development**

An example of a recent joint development project is the agreement between the Los Angeles County Metropolitan Transportation Authority and the Catellus Development Corporation involving redevelopment of Union Station. In this case, Catellus reimbursed the Authority the amount of \$8.5 million. (It should be noted that in addition to station development, these funds were also used to cover costs of certain roadway improvements, development of Metro Plaza and a busway connection, a portal, public parking, design services, and the preparation of an FEIR.)

◦ **Property Transfer**

Some of the costs of building the Urban Ring may be offset by property transfer arrangements between the MBTA and private landholders. This will apply when the MBTA needs to acquire a new right-of-way, and is able to trade MBTA property for property in the proposed right-of-way. This strategy is assumed to generate revenues on a one-time basis.

◦ **Station Sponsorship**

The funding contribution from station sponsorship is estimated based on a number of stations likely to be chosen for sponsorship and the current value of such sponsorship, based on available information from the MBTA. This strategy is assumed to generate revenues on an annual basis.

◦ **Advertising**

The value of advertising contributions to the funding of the Urban could be assumed to generate revenues on an annual basis.

◦ **Right-of-Way Access**

The value would be based on lease rates established by the MBTA and managed by its property manager Transit Realty Associates. This strategy is assumed to generate revenues on an annual basis.

◦ **General Obligation Bonds**

General obligation (GO) bonds are currently the most common means used by the State to finance major public infrastructure, such as the Central Artery Project. The general tax revenue of the State backs these bonds. The amount potentially available from this source is a function of overall transportation funding for the region, initiated through the Metropolitan Planning Organization's transportation planning process.

◦ **Mortgage Recording Fee**

In order to estimate the possible income from a mortgage recording fee, we would apply two alternative calculations to derive a low and a high estimate of revenue. For the low estimate, we would estimate revenues on a per transaction basis. The number of parcels that fall within the fee jurisdiction is a key input. This strategy would be assumed in both cases to generate revenues on an annual basis.

◦ **Auto Excise Tax Surcharge**

Potential revenue derived from an auto excise tax surcharge could be calculated based on the number of vehicles registered in each of the 101 Boston MPO communities in 1997, applying an annual surcharge to each vehicle. This strategy is assumed to generate revenues on an annual basis.

◦ **Tax Increment Financing³**

Ideally, to assess the potential revenue from a tax increment financing program, it is necessary to know the current assessed value of all the parcels within the TIF district, the mil rate, the anticipated increase in property values and the percentage of the tax increment that will be dedicated to Urban Ring funding. Tax increment financing can be applied as a one-time basis or over time with a specified expiration date. However, because the tax benefits accruing from increased property valuation are not realized until after a project is completed or, at least, in its initial phase of operation, TIF is normally applied as a means of financing on-going operating and maintenance costs after a project is in operation or to support later phases of project development.

◦ **Contribution from shuttle operators**

There are currently at least 12 private shuttles operating in the Corridor. MASCO currently spends about \$2.5 million annually to operate its shuttle services and UMass Boston spends around \$1 million annually. Given that the Urban Ring will substantially reduce the transportation needs that these shuttles currently serve, it is reasonable to expect that these private organizations may be willing to make payments to the Urban Ring in return for no longer being required to operate their shuttles.⁴ This strategy could be assumed to generate revenues on an annual basis.

◦ **Use of non-earmarked TIP funds**

The TIP was reviewed for the purpose of identifying any state or federal funds available for general infrastructure improvements that have not already been earmarked for specific projects. A possible source that was considered was the CMAQ program. However, it was determined that the majority of funds specified in the TIP are dedicated to specific projects and those funds which are not associated with a specific project represent a negligible source of funding.

◦ **Betterment Fee**

Possible funding from instituting a betterment fee within the Corridor, a one-time fee rate per square foot could be applied to all (existing and new) non-residential uses within the station catchment areas. This strategy is assumed to generate revenues as a one-time charge, although that charge may be collected in one or several installments. Furthermore, because a betterment fee is not technically considered a tax, it may be applied to tax-exempt, as well as taxable, properties.

³ For the purpose of this analysis, Tax Increment Financing is defined as a mechanism that captures increased tax revenues accruing from increased property value produced by a specific public investment. This mechanism is defined more fully in the February, 1998 Innovative Funding Techniques Technical Memorandum. Massachusetts has enacted legislation allowing for "tax increment financing" as an economic development strategy. However, this application is applied in Massachusetts as a "tax increment exemption," exempting from taxation portions of the increased value of a parcel created by development in primarily economically-distressed areas.

⁴ Other shuttle operators in addition to MASCO and UMass include: University Park at MIT, Harvard Medical School, CambridgeSide Galleria, Boston City Hospital, the Boston Globe and Lotus Development Corporation.

° **Impact Fee**

Possible funding from instituting a transit impact fee within the Corridor, a fee rate per square foot of new non-residential uses could be applied to development within the station catchment areas. This strategy is assumed to generate revenues on a one-time basis.

° **Local Option Sales Tax**

To calculate the possible amount of money that might be generated by a local option sales tax, the amount of sales tax revenue generated by each of the compact communities could be determined and then multiplied by a certain percentage to estimate the funding that might be available for the Urban Ring. No escalation in sales tax revenues would be assumed. This strategy is assumed to generate revenues on an annual basis.

° **Parking surcharge**

Based on the number of commercial and private off-street parking spaces within the catchment areas of the Urban Ring Stations, a parking surcharge could be charged per use of the parking space. The low estimate would assume that the surcharge is only applied to public (commercial) spaces. The high estimate could apply the surcharge to both public and private spaces. This strategy is assumed to generate revenues on an annual basis.

° **Gas Tax**

An increase in the gas tax dedicated to funding the Urban Ring is another mechanism that could be explored. Such a tax would be multiplied by the current consumption levels to estimate the annual income stream. This strategy is assumed to generate revenues on an annual basis.

7.3.3 Financial Analysis Methodology

The MBTA is currently updating a 20-year financial analysis model that will be used to 1) analyze the financial capacity of the Authority to undertake implementation of each phase of the Urban Ring project; 2) identify the funding needs and stream of cash and revenues associated with each phase and alternative; and 3) begin the process of developing a finance plan for each phase of the Urban Ring. The financial analysis model, which is expected to be completed by September 2001, is being developed consistent with FTA's June 2000 *Guidance for Transit Financial Plans*. Financial analysis in support of the Urban Ring will be conducted following the MIS, and will incorporate all of FTA's guidance, including the New Starts local financial commitment criterion. The financial analysis and results for the preferred alternative will be presented in the project's EIS for Phase 2 and, later, for Phase 3.

Table 7-1

MAGNITUDE CAPITAL COST OF CONCEPTUAL ALTERNATIVES					
URBAN RING MIS (all costs in 2001 dollars)					
COST COMPONENTS	PHASE 1	PHASE 2	PHASE 3 ALTERNATIVE A1	PHASE 3 ALTERNATIVE A2	PHASE 3 ALTERNATIVE B
DIRECT CONSTRUCTION					
AT-GRADE STRUCTURES	\$0	\$25,000,000	\$21,986,000	\$0,888,000	\$81,217,200
BELOW-GRADE STRUCTURES	\$0	\$45,000,000	\$243,963,600	\$293,863,500	\$239,960,100
BUSWAY, AERIAL AND BRIDGE	\$0	\$40,000,000	\$11,160,000	\$11,160,000	\$11,910,000
TERMINAL FACILITIES	\$0	\$0	\$20,000,000	\$26,000,000	\$21,000,000
UTILITY RELOCATIONS	\$0	\$11,000,000	\$30,454,500	\$19,812,500	\$33,504,700
STATIONS	\$0	\$79,000,000	\$362,960,000	\$381,390,000	\$283,860,000
CONTINGENCY @ 50%	\$0	\$97,500,000	\$376,738,500	\$385,890,500	\$325,688,110
SUBTOTAL	\$0	\$292,500,000	\$1,130,209,600	\$1,143,841,900	\$977,065,310
SYSTEM-WIDE ELEMENTS					
SIGNALS AND CONTROL BUILDINGS	\$0	\$1,000,000	\$2,050,000	\$0,000,000	\$2,000,000
TRACTION POWER SUBSTATIONS	\$0	\$0	\$20,000,000	\$20,000,000	\$20,000,000
ROLLING STOCK	\$40,000,000	\$80,000,000	\$280,000,000	\$302,000,000	\$290,000,000
MAINTENANCE FACILITIES	\$30,000,000	\$50,000,000	\$94,850,000	\$55,000,000	\$94,000,000
EMERGENCY EXIT SHAFTS	\$0	\$0	\$18,000,000	\$18,000,000	\$11,250,000
CONTINGENCY @ 50%	\$15,000,000	\$25,000,000	\$187,350,000	\$149,550,000	\$183,375,000
SUBTOTAL	\$85,000,000	\$136,000,000	\$582,850,000	\$448,600,000	\$681,625,000
IMPACTS AND MITIGATIONS					
WETLANDS MITIGATION	\$0	\$280,000	\$100,000	\$100,000	\$100,000
NOISE & VIBRATION CONTROL	\$0	\$0	\$1,000,000	\$1,000,000	\$2,500,000
EMI/EMP/EMF MITIGATION	\$0	\$0	\$2,000,000	\$2,500,000	\$5,000,000
HAZARDOUS MATERIALS	\$0	\$10,000,000	\$46,200,000	\$48,200,000	\$66,200,000
CONTINGENCY @ 50%	\$0	\$6,125,000	\$24,900,000	\$24,900,000	\$36,900,000
SUBTOTAL	\$0	\$16,325,000	\$74,700,000	\$74,700,000	\$110,700,000
R.O.W. ACQUISITIONS					
BUSWAY AND TRACK AREAS	\$0	\$10,000,000	\$2,000,000	\$2,000,000	\$8,575,000
CONTINGENCY @ 50%	\$0	\$5,000,000	\$1,000,000	\$1,000,000	\$4,287,500
SUBTOTAL	\$0	\$15,000,000	\$3,000,000	\$3,000,000	\$12,862,500
TOTAL CAPITAL COSTS	\$85,000,000	\$458,825,000	\$1,796,869,600	\$1,669,201,600	\$1,682,553,010
DESIGN, PROJECT ADMINISTRATION, CONSTRUCTION MANAGEMENT & MIS	\$53,815,000	\$54,347,250	\$538,887,800	\$499,077,400	\$558,795,800
GRAND TOTAL	\$98,815,000	\$513,172,250	\$2,335,947,540	\$2,168,289,140	\$2,167,216,938

Table 7-2
Performance Measures¹
MBTA Operating Expenses by Measure and Mode

Operating Expense Measure	Mode			
	Bus	BRT	Heavy Rail	Light Rail
Service Efficiency				
Cost Per Vehicle Revenue Mile ²	\$7.34	\$9.54	\$8.22	\$16.00
Cost Per Vehicle Revenue Hour ²	\$83.06	\$107.98	\$180.86	\$240.00
Cost Effectiveness				
Cost Per Passenger Mile	\$0.60	\$0.60	\$0.38	\$0.51
Cost Per Unlinked Passenger Trip	\$1.69	\$1.69	\$1.37	\$1.27

¹ Source: 1998 National Transit Database for MBTA except BRT.

² Assumed 30% increase for BRT over Bus.

Table 7- 3
Service Efficiency
Estimated Annual Operation and Maintenance Costs

Phases¹	1	2	3		
Alternatives			A1	A2	B
Motor Bus (Bus)					
Vehicle Hours	282,767	124,970	167,875	167,875	142,535
Vehicle Hours Cost	\$23,486,627	\$10,380,008	\$13,943,698	\$13,943,698	\$11,838,957
Vehicle Miles	3,013,109	1,436,583	1,870,811	1,870,811	1,639,587
Vehicle Miles Cost	\$22,116,220	\$10,544,519	\$13,731,753	\$13,731,753	\$12,034,569
Bus Rapid Transit (BRT)					
Vehicle Hours		196,382	178,241	178,241	178,241
Vehicle Hours Cost	\$0	\$21,204,936	\$19,246,107	\$19,246,107	\$19,246,107
Vehicle Miles		2,123,919	1,933,008	1,933,008	1,933,008
Vehicle Miles Cost	\$0	\$20,266,435	\$18,444,762	\$18,444,762	\$18,444,762
Light Rail Transit (LRT)					
Vehicle Hours			95,887		102,798
Vehicle Hours Cost	\$0	\$0	\$23,016,715	\$0	\$24,675,632
Vehicle Miles			2,062,874		2,222,686
Vehicle Miles Cost	\$0	\$0	\$33,005,984	\$0	\$35,562,976
Heavy Rail (HR)					
Vehicle Hours				122,667	
Vehicle Hours Cost	\$0	\$0	\$0	\$22,185,554	\$0
Vehicle Miles				3,178,968	
Vehicle Miles Cost	\$0	\$0	\$0	\$26,131,117	\$0
Total Vehicle Hours Cost	\$23,486,627	\$31,584,944	\$56,206,520	\$55,375,358	\$55,760,696
Total Vehicle Miles Cost	\$22,116,220	\$30,810,954	\$65,182,499	\$58,307,632	\$66,042,307

¹ Phasing assumptions for operating statistics are Phase 1 - 2003, Phase 2 - 2010, Phase 3 - 2025.

	Operating Expenses*	
	Veh Rev Mile	Veh Rev Hour
HR	\$8.22	\$180.86
LRT	\$16.00	\$240.04
BRT	\$9.54	\$107.98
Bus	\$7.34	\$83.06

* Operating Expenses taken from the Performance Measures Table in the 1998 National Transit Database Transit Profile for the MBTA except BRT. Assumed 30% increase for BRT based on lower reliability, availability and using articulated buses.

Table 7- 4
Service Efficiency
Operating Statistics (Weekday Numbers)¹

Phase/Alternative	1	2	3 A1	3 A2	3 B
Vehicle Miles					
Motor Bus	10,464	4,989	6,497	6,497	5,694
BRT Bus		7,376	6,713	6,713	6,713
Light Rail Transit (LRT) ²			7,164		7,719
Heavy Rail (HR) ³				11,040	
Vehicle Hours					
Motor Bus	982	434	583	583	495
BRT Bus		682	619	619	619
Light Rail Transit (LRT) ²			333		357
Heavy Rail (HR) ³				426	

¹ Source of Operating Statistics is The Urban Ring MIS Operating Statistics from CTPS Table 11 dated May 1, 2001.

² The CTPS statistics were based on train miles and hours which were multiplied by three to reflect an assumed consist size of 3 cars (vehicles) per train for the LRT service.

³ The CTPS statistics were based on train miles and hours which were multiplied by six to reflect an assumed consist size of 6 cars (vehicles) per train for the Heavy Rail service.

Table 7-5
Service Efficiency
Operating Statistics¹ (Annual Hours and Annual Miles)

Phase/Alternative	1	2	3 A1	3 A2	3 B
Vehicle Miles					
Motor Bus	3,013,109	1,436,583	1,870,811	1,870,811	1,639,587
BRT Bus	-	2,123,919	1,933,008	1,933,008	1,933,008
Light Rail Transit (LRT)	-	-	2,062,874	-	2,222,686
Heavy Rail (HR)	-	-	-	3,178,968	-
Vehicle Hours					
Motor Bus	282,767	124,970	167,875	167,875	142,535
BRT Bus	-	196,382	178,241	178,241	178,241
Light Rail Transit (LRT)	-	-	95,887	-	102,798
Heavy Rail (HR)	-	-	-	122,667	-

For all modes, using 250 Weekdays, 57 Saturdays, 58 Sundays and a Saturday & Sunday reduction factor = 0.33

1 Formulae: Annual Vehicle Hours =(Weekdays*Hours per day) + (Saturdays*Reduction factor*Hours) + (Sundays*Reduction factor*Hours)

Annual Vehicle Miles = Weekdays*Miles per day + Saturdays*Reduction factor*Miles +Sundays*Reduction factor*Miles

Table 7-6
Urban Ring MIS
Innovative Financing Options

	Conventional	Innovative	Aggressive
Local/ Municipal	• Increase MBTA Assessments • Payment in Lieu of Taxes (PILOT) • Linkage Payments	• Mortgage Recording Fee • Auto Excise Tax Surcharge • Tax Increment Financing	• Betterment Fee • Impact Fee • Local Option Sales Tax
Private Sector	• Joint Development • Property Transfer • Station Sponsorship • Advertising • Right-of-Way Access	• Contributions from Shuttle Operators	• Parking Surcharge
State	• General Obligation Bonds	• Use of non-earmarked TIP funds	• Gas Tax

Chapter 8

EVALUATION OF ALTERNATIVES

8.0 EVALUATION OF ALTERNATIVES

The goals and objectives set forth in Chapter 1 provide the overall framework for evaluating and comparing the alternatives. The goals, objectives, and evaluation measures were consolidated into the following five major categories:

- Transportation performance
- Environmental impacts and benefits
- Economic development, land use and urban design
- Cost effectiveness
- Implementation and phasing

The findings described below are based on how well each alternative would perform when judged against the evaluation measures associated with these five categories. The potential impacts of each of the Urban Ring alternatives at each phase were evaluated and compared to the No Build and TSM alternatives at each phase. Tables 8-1, 8-2, and 8-3 summarize the evaluation results for Phases 1, 2, and 3, respectively.

8.1 Transportation Benefits

The transportation benefits of the Urban Ring start with implementation of the new and improved bus routes in Phase 1. The benefits increase significantly with the implementation of BRT routes and supporting elements of Phase 2, and are maximized in Phase 3 with the addition of rail in the most heavily traveled portion of the Corridor. Highlights of the Phase 3 rail alternatives compared to the Phase 3 No-Build and TSM Alternatives are provided below, followed by more detailed information organized within six categories of transportation benefits.

- Alternatives A1, A2, and B are projected to have at least 290,000 boardings per day in the year 2025 for the Rail, BRT and TSM bus elements combined. By comparison, TSM in Phase 3 would have approximately 50,000 daily boardings.
- Alternatives A1, A2 and B would save travelers approximately 50,000 hours per day compared to the 2025 “No Build” Alternative. Most of those time savings would be realized by existing transit users.
- The highest Urban Ring ridership would be in the core of the Corridor between the Orange Line at Assembly Square/Sullivan Square and the Silver Line at Dudley Square. This portion of the Corridor would, for the rail and BRT routes combined, have over 200,000 boardings per day for any of the build alternatives.
- The analysis of alternatives shows that ridership would drop off significantly south of Dudley Square regardless of alignment or technology.
- Alternatives A1, A2 and B would achieve reductions in central subway congestion by providing a faster and more direct route to reach Corridor destinations by transit.
- Alternatives A1, A2 and B would serve a large number of mobility-impaired households as measured by the number of households below the poverty line (over 17,000) and households without automobiles (over 35,000) within the station catchment areas of each alternative.

8.1.1 Accessibility and Mobility

8.1.1.1 Travel Time Savings

The mobility of transit users, defined as the speed of transit trips in the system, would also be greatly improved by the Urban Ring alternatives. At a system-wide level the Phase 1 TSM Alternative would save approximately 3,870 hours of travel time per day compared to the No-Build Alternative. The Phase 2 BRT Alternative would save approximately 17,117 hours of travel time per day compared to the No-Build Alternative. By comparison, the Phase 2 TSM Alternative would save 1,404 hours per day. Thus, the Phase 2 BRT Alternative would save 15,713 more hours of travel time per day than would the Phase 2 TSM Alternative.

Phase 3 Alternatives A1, A2, and B would save approximately 50,000 hours per day of travel time compared to the No-Build Alternative, while the Phase 3 TSM Alternative would save only 2,829 hours per day. Thus, the Phase 3 rail alternatives would save approximately 47,000 more hours of travel time per day than would the Phase 3 TSM Alternative. Approximately 75 percent of the daily travel time savings would be realized by existing transit users, and the remainder by non-transit users such as autos and trucks due to fewer vehicles on the road. The projected travel time savings are similar for each of the Phase 3 rail alternatives. The travel-time savings for transit users are evenly divided between in-vehicle and out-of-vehicle time. The shorter, more direct Urban Ring routes would result in less time spent within a transit vehicle to complete Corridor trips. The out-of-vehicle travel-time savings would result from the convenient accessibility of the Urban Ring LRT and BRT station stops, as well as the high frequency of service.

Seven example origin-destination pairs representing various areas of the Corridor and types of trips were analyzed which showed significant travel-time savings for individual one-way transit trips in the Phase 2 BRT Alternative and Phase 3 rail Alternatives compared to the respective No-Build Alternatives. For the example origin-destination pairs, the travel-time savings are attributable to one or more of the following features of the transit system with the Urban Ring service compared to the transit system without it:

- Routing within the Corridor is more direct
- Average speed of transit vehicles is higher
- Some transfers are eliminated and others made more direct
- Frequency of service is higher
- Connections with radial transit and commuter rail enable trips to bypass downtown Boston

Travel time savings are achieved for transit trips within the Corridor, as well as for transit trips between the Corridor and locations outside the Corridor.

8.1.1.2 Systemwide Transfers

The number of daily systemwide transfers would experience very little change (+150) with the Phase 1 TSM Alternative despite the projected systemwide ridership increase of 6,600 per day associated with that alternative. This is due to the increased percentage of transit trips that can be made without a transfer in the Phase 1 TSM Alternative compared to the Phase 1 No-Build Alternative.

In the Phase 2 BRT Alternative the number of systemwide transfers would be reduced by 7,500 per day compared to the No-Build Alternative. By comparison, transfers would be reduced by only 1,100 if the Phase 1 TSM Alternative were to continue in operation. Thus, the Phase 2 BRT Alternative would eliminate 6,400 more systemwide transfers than would the Phase 2 TSM Alternative. The reduction in transfers combined with the significant increase in systemwide ridership compares favorably with the relatively low ridership and reduction in transfers associated with continued operation of the Phase 1 TSM.

The Phase 3 rail alternatives would increase the number of systemwide transfers by between 45,000 and 63,000 per day compared to the No Build Alternative. The smallest increase in transfers would be associated with Alternatives A1 and B, primarily because they would provide single seat rides from the

entire Green Line Extension and the Urban Ring via a connection between the lines that would be located just west of New Lechmere. Alternative A2 would offer single seat rides via a connection with the Orange Line, but only as far north as Wellington as currently defined. By comparison, the Phase 3 TSM Alternative would increase systemwide transfers by a much smaller 7,250 per day compared to the No-Build Alternative, albeit with much lower overall ridership than any of the Phase 3 rail alternatives.

8.1.1.3 Network Connectivity

The accessibility of the MBTA transit system to Corridor residents and workers would be greatly increased as a result of the Urban Ring alternatives due to the location of new and improved stations closer to transit users. In addition, the accessibility to jobs and residences will be enhanced by the greatly improved connectivity of the transit system. The Phase 1 TSM Alternative connects with every existing and planned transit line and all but three of the commuter rail lines and provides a fair improvement over the No-Build Alternative.

The Phase 2 BRT Alternative would provide considerable further improvements by connecting with every existing and planned transit line and commuter rail line in the MBTA system, and increasing the speed and convenience of those connections. By comparison, the No-Build Alternative provides no improvement in connectivity and the Phase 2 TSM Alternative would provide only modest improvement.

In Phase 3, each of the rail alternatives achieves excellent network connectivity by providing high frequency rail connections with BRT routes and other rail lines. By comparison, the No-Build Alternative provides no improvement in connectivity and the Phase 3 TSM Alternative would provide only modest improvement. The local bus routes in the MBTA system provide an important feeder/distribution function by extending the reach of the higher quality Urban Ring services further into neighborhoods and employment centers in the Phase TSM, Phase 2 BRT, and each of the Phase 3 rail alternatives.

8.1.2 Daily Ridership

8.1.2.1 Urban Ring Total Ridership

Daily ridership on the Urban Ring service is expected to be 40,000 in Phase 1 on the new and improved crosstown and express buses. Implementation of the BRT routes and improved radial connections in Phase 2 builds upon the Phase 1 services and increases total Urban Ring daily ridership to 106,000. By comparison, the Phase 2 TSM Alternative would have 45,550 daily riders.

The addition of rail transit service in Phase 3 would build daily Urban Ring ridership further to approximately 290,000, depending upon the rail transit alignment and technology chosen. While the totals are similar, the transit-mode breakdown differs. The totals are approximately 282,500 for Alternative A1; 289,350 for Alternative A2; and 293,800 for Alternative B. By comparison, the Phase 3 TSM Alternative would have 49,650 daily riders, a total that is actually less than the Phase 2 TSM, which is likely due to increased congestion and longer trip times projected for general traffic roadways in 2025 compared to 2010.

In Phase 3 Alternatives A1, A2 and B the total ridership is comprised of the EC and CT buses; the BRT routes, and the rail routes combined. For Urban Ring buses, most of the ridership is associated with the CT routes, which is to be expected since the EC routes are competing with the existing and well-established radial rail lines. The CT routes provide direct, limited stop service currently lacking in the crosstown travel market. Total BRT ridership in Phase 3 drops from the levels of BRT ridership in Phase 2, because the BRT5 route is replaced by rail, and other BRT to BRT connections are replaced by BRT to rail connections.

8.1.2.2 Systemwide Change

The Phase 1 TSM Alternative would increase systemwide linked transit person trips by 6,600 per day compared to the No-Build Alternative. The Phase 2 BRT Alternative would increase systemwide linked transit person trips by 15,000 per day compared to the No-Build Alternative, but only 1,850 riders per day if the Phase 1 TSM continued in operation rather than the Phase 2 BRT. Thus, the Phase 2 BRT

Alternative would increase systemwide linked transit person trips by almost 13,000 more than the increase projected for the Phase 2 TSM Alternative.

The Phase 3 rail alternatives would each result in approximately 47,000 additional linked transit person trips in the system per day compared to the No-Build Alternative. Continued operation of the Phase 1 TSM Alternative in Phase 3 without rail or BRT would increase the linked transit person trips by 5,500 per day. Thus, the Phase 3 rail alternatives would increase systemwide linked transit person trips by over 40,000 more than the increase projected for the Phase 3 TSM Alternative.

In addition to gaining substantial new transit riders, the Urban Ring alternatives would divert even larger numbers of existing transit users from other lines in the MBTA system due to superior trip times. In the Phase 3 rail alternatives the North and South Side Commuter Rail Lines would together experience an increase of over 17,000 riders per day compared to the 2025 No Build. These increases in commuter rail ridership would be attributable to the new and improved commuter rail stations that are part of the Phase 2 BRT Alternative that would continue in operation in Phase 3. This improved connectivity would facilitate easy transfer between commuter rail and the Urban Ring services.

8.1.2.3 Mode Share Change

At each phase the Urban Ring would result in an increase in regional transit mode share compared to the No-Build. Transit mode share, which is the percentage of regional trips made by transit, is an important measure of how effective the alternative is expected to be at diverting automobile trips to transit. The No-Build regional transit mode share is projected to increase from a 5.5% share in the 1995 Base Year to 6.02% share in 2003; 6.44% share in 2010; and 6.82 share in 2025 thanks to projects in the Regional Transportation Plan and other changes in the relative attractiveness of transit.

With the Urban Ring Phase 1 TSM Alternative, the regional transit mode share is projected to increase from a 6.02% share in the 2003 No-Build to a 6.06% share, which represents an absolute increase of +0.04. The increase represents growth of 0.66% over the No-Build Alternative. In a mature transit system such as the MBTA it is typically more difficult to achieve significant increases in transit mode share because a large percentage of the population most likely to use transit are already using it, albeit often with inconvenient or time consuming routing. Moreover, the impact of these new transit riders, that are likely concentrated in and around the Corridor, is small relative to all trips in the entire region.

With the Phase 2 BRT Alternative the regional transit mode share is projected to increase from a 6.44% share in the No-Build to a 6.53% share for an absolute increase of +0.09 which represents a more significant 1.4% increase over the No-Build. By comparison, the Phase 2 TSM Alternative is projected to increase the regional transit mode share from a 6.44% share to 6.45% share, which represents virtually no increase in regional transit mode share, compared to the No-Build Alternative

The Phase 3 rail alternatives are projected increase regional transit mode share from a 6.82% share to either a 7.09% share (Alternatives A1 and A2) or a 7.10% share (Alternative B) for a much larger absolute increase of +0.27 or +0.28. These figures represent an increase of approximately 4% growth over the No-Build Alternative. By comparison, the Phase 3 TSM Alternative is projected to increase the regional transit mode share from a 6.82% share to a 6.86% share, which represents an absolute increase of +0.04. The increase achieved by Phase 3 TSM represents growth of only 0.59% over the No-Build Alternative.

8.1.3 Transit System Efficiency

A major problem identified during this study, as well as during previous studies, is the growing disconnect between regional and Corridor travel patterns and the existing transit system. The radial configuration of the existing transit system is not efficient or effective at serving the crosstown travel market. At each phase, the Urban Ring alternatives would progressively boost transit system efficiency by providing direct routing between transit origins and destinations that currently require transfers in the central subway system. Utilization of existing infrastructure is an important measure of efficiency, and each of the

alternatives in Phase 2 and Phase 3 will make use of underutilized active and abandoned rail and roadway rights-of-way along their routes. Alternatives A1 and B would interline at New Lechmere with the planned Green Line extension to Medford Hillside enabling single seat rides between that line and the Urban Ring. Alternative A2, which uses Heavy Rail Transit, would also boost transit system efficiency because it would interline with the existing Orange Line at Sullivan Square. At Sullivan Square Alternative A2 would utilize the existing second center platform and the existing third track (currently used for testing cars) between Sullivan Square and Wellington. Moreover, Alternative A2 could utilize the existing Wellington maintenance facility which has sufficient capacity and room for expansion to handle the Urban Ring Heavy Rail vehicles.

In summary, the Phase 1 TSM Alternative would provide good improvement in transit system efficiency due to its increased connections and increased availability of single seat rides. The Phase 2 BRT Alternative would rate very good on improving transit system efficiency due to its utilization of available rights-of-way to increase transit capacity and the greatly improved connections with commuter rail. The Phase 3 rail alternatives each would greatly improve transit system efficiency through their ability to interline with existing transit lines (Alternatives A1 and B with the Green Line Extension, and Alternative A2 with the Orange Line). The No-Build Alternatives at each phase would not provide any increase in transit system efficiency.

8.1.4 Transit Congestion

Transit congestion – crowding and delays in the central subway system – is a chronic problem that will be only partially addressed by capacity improvements contained in the current Regional Transportation Plan. Compared to the No-Build, the Phase 1 TSM Alternative would be good at relieving some pressure on portions of the central subway system and some crowded local bus lines by providing more direct and convenient routing. The Phase 2 BRT Alternative would be even more effective than Phase 1 TSM thanks to its connection with every commuter rail line in the system. However, it is in Phase 3 that central subway congestion is expected to become most significant. Even with planned improvements such as using three car trains it is conservatively estimated that the Green Line will reach a demand to capacity ratio of 1.4 to 1 (40 percent over capacity) in the peak hour by the year 2025.¹ The projected congestion on the Green Line would be even worse if the assumed 1-1/2 minute peak period headways in the central subway are lengthened due to use of three-car trains. Transit congestion would not be adequately addressed by the No-Build Alternative or the Phase 3 TSM Alternative. However, with the Phase 3 Urban Ring rail alternatives, tens of thousands of daily transit trips that would otherwise be forced to pass-through the central subway would instead choose the faster and more direct Urban Ring service that bypasses downtown Boston.

Alternatives A1 and B would reduce peak hour maximum load point volumes on the Green Line down to levels 4 percent above capacity, while Alternative A2 would bring congestion down to 17 percent above capacity. Alternatives A1 and B would operate as a branch of the Green Line in tandem with the Green Line Extension to Medford Hillside, and therefore are able to divert a higher number of Green Line riders from the central subway. Congestion problems forecast for the other radial transit lines are less severe than the Green Line, though the same principle applies. The Urban Ring service would also divert transit trips from the Red Line and other radial transit lines. Removing pass-through transfers from the central subway system enables more of its limited capacity to be used for serving Downtown Boston and the radial markets. Thus, the alternatives would create new transportation capacity for the region while freeing capacity for the central subway.

8.1.5 Income, Auto Ownership, and Minority Populations

The number of households below the poverty level is one of the criteria used to measure Environmental Justice. Presidential Executive Order 12898, issued in 1994, directed every federal agency to make environmental justice part of its mission by identifying and addressing the effects of all programs, policies,

¹ Source: CTPS - June 2001

and activities on “minority populations and low-income populations.” As such, the FTA is examining the effects that federally funded projects will have on these communities.

In support of the Executive Order, the Executive Office of Environmental Affairs of the Commonwealth of Massachusetts (MEPA) issued a draft Environmental Justice Policy in December 2000. The public comment period for this document closed July 2, 2001 and MEPA is currently reviewing comments received from the public. It is expected that a final version will be adopted later this year.

The purpose of this policy is the support of environmental justice for all residents of Massachusetts. As a project seeking support from both the Commonwealth of Massachusetts and the FTA, the Urban Ring MIS is identifying the EJ effects of the Urban Ring. One factor measuring EJ concerns is the impact of the project on households below the poverty level.

There are large numbers of households within the station catchment areas of Alternatives A1, A2 and B that can be categorized as mobility impaired due to low-income level or lack of access to an automobile. The Phase 1 TSM Alternative, Phase 2 BRT Alternative, and each of the Phase 3 rail alternatives would progressively improve transit access to such households. Based on 1990 census data, the Phase 3 Alternative A1 station catchment areas contained 17,204 households below the poverty line and 35,314 households without an automobile. By comparison, Alternative A2 had nearly identical 17,235 households below the poverty line and 35,372 households without an automobile. Alternative B was very similar, with 17,416 and 35,755 households, respectively².

The Phase 1 TSM Alternative, Phase 2 BRT Alternative, and each of the Phase 3 rail alternatives would progressively improve transit access to minority populations. Based on Year 2000 Census data there were between 115,000 and 118,000 minority residents within the catchment areas of the Urban Ring stations. Minorities represent 51 percent of the total population within these catchment areas in Year 2000.

8.1.6 Non-Motorized Network

The Phase 1 bus routes are not expected to have any negative impact on the non-motorized network compared to the No-Build. Phase 1 could have somewhat of a positive impact depending upon the extent to which bicycle carriers are included in the new vehicles and bicycle storage facilities included at bus stops. The full- or partial-grade separation featured in the Phase 2 and 3 Alternatives combined with the new accessible stations that would be built under those alternatives, would result in more significant benefits to the pedestrian and bicycle network within the Corridor compared to the TSM or “No Build” Alternatives.

8.2 Environment

Information concerning baseline environmental conditions within the Corridor was developed and used to evaluate and compare the potential impacts of each Alternative relative to the following subject areas:

- Air quality improvement
- Noise, vibration, and EMF impact
- Wetlands impact
- Low income/minority access
- Daily VMT change
- Auto person trips change

² The most recent Census household data on income and auto ownership is from 1990. Household data from the 2000 Census is expected to be available in 2002.

8.2.1 Air Quality Improvement

Reductions in the emissions of each of the three primary air pollutants (volatile organic compounds, or VOCs; carbon monoxide, or CO; and nitrogen oxides, or NOx) are projected to occur with the Phase 1 TSM Alternative, the Phase 2 BRT Alternative, and each of the Phase 3 rail alternatives. The air quality improvements increase significantly as each Phase is added. The No-Build Alternative would have no beneficial impact on air quality. At each Phase the projected reductions in air pollutant emissions would be directly attributable to, and approximately proportional to, the reduction in Vehicle Miles Traveled (VMT) under each alternative. The greatest absolute reduction in air pollutants achieved by the Urban Ring alternatives is in the quantity of Carbon Dioxide. Compared to No-Build, The Phase 1 TSM Alternative would reduce Carbon Dioxide levels in the region by 6,889 kg/day. The Phase 2 BRT Alternative would reduce Carbon Dioxide levels in the region by 25,561 kg/day. The Phase 3 rail alternatives would reduce Carbon Dioxide levels in the region by 172,941 kg/day (Alternative A1), 187,061 kg/day (Alternative A2), and 179,952 kg/day (Alternative B).

8.2.2 Noise, Vibration, and EMF Impact

8.2.2.1 Noise and Vibration

There is unlikely to be any significant increase in noise and vibration impact in the Phase 1 TSM Alternative compared to No-Build because there is no construction associated with the routes and most of the existing streets to be used by the new routes are currently used by other buses. One additional bus every 10-12 minutes during the peak period for Urban Ring buses is likely to have a very low impact relative to the No-Build.

In Phase 2 the proposed BRT routes include some segments of new busway within alignments not currently in use for transportation purposes. Such locations include the abandoned rail corridor in East Chelsea and the Grand Junction Rail Corridor in East Cambridge west of Main Street. In these and similar locations it is expected that the BRT alternative would have a medium potential noise and vibration impact compared to the No-Build. For the BRT route through MIT the Vassar Street alignment option provides greater physical distance from more of the sensitive receptors compared to the Grand Junction alignment.

In Phase 3 the light rail alignment associated with Alternative B has a high potential for noise impact along the at-grade portions of the alignment between Assembly Square and New Lechmere in Somerville and Boston, as well as along the Grand Junction rail corridor west of Main Street in Cambridge. By comparison, Alternatives A1 and A2 are 100% in tunnel south of Sullivan Square and would have no noise impact. The differences between Alternatives A1, A2, and B are less pronounced with regard to potential vibration impacts due to the ability of vibration to transmit underground. Nevertheless, the potential for vibration impacts are highest for Alternative B compared to Alternatives A1 and A2 because its alignment along the Grand Junction right-of-way between Kendall Square and Cambridgeport places it in closer proximity to a greater number of vibration sensitive receptors. There would be no significant noise or vibration impacts associated with the TSM Alternative.

8.2.2.2 Electromagnetic Field Interference

There are no EMI impacts associated with Phases 1 or 2 because they do not utilize electrically powered vehicles. In Phase 3, the Urban Ring project would use transit vehicles powered by electric traction motors. In Phase 3, the highest potential EMI impacts are associated with Alternative B, the second highest potential impact would be with Alternative A1, and the lowest potential impact of the three would be Alternative A2 due to its power source (third rail) being the furthest from the sensitive receptors.

In summary, Alternative B has the highest potential EMF/EMI impacts and would be the most difficult and expensive to mitigate. Alternatives A1 and A2 in tunnel have fewer impacts due to greater distance from receptors offered by the tunnel alignment compared to the surface alignment of Alternative B.

8.2.3 Wetlands Impact

There are no wetland impacts associated with the Phase 1 TSM Alternative and no difference between it and the No-Build that also would have no impact. The Phase 2 BRT Alternative involves some construction of new busways along or adjacent to abandoned and active railroad rights of way that may involve limited impact to some wetland areas. Impacts, if any, are expected to be minor and would be mitigated through replication or other means. The Phase 3 rail alternatives would be unlikely to have any impact on wetlands because they are mostly in tunnel and the at-grade portions do not pass through known wetlands.

8.2.4 Low Income/Minority Access

Based on 1990 data (the most recent available) average household income in the Corridor was \$29,000 per year compared to \$47,000 per year for the region as a whole. Minorities comprised 45% of the Corridor population compared to 21% of the population in the region as a whole. In each phase the Urban Ring service would provide a significant increase in the reach and quality of the transit within low income and minority neighborhoods providing them with increased access and mobility to reach other neighborhoods, employment centers, commercial centers, and other destinations within and outside the Corridor. The No-Build Alternative at each phase would provide no improvement in transit service to low income and minority neighborhoods beyond that already contained in the Regional Transportation Plan.

8.2.5 Daily VMT Change

Each phase of the project is expected to result in decreased regional Vehicle Miles Traveled (VMT) due to increased attractiveness of public transit versus travel by automobile. There would be no reduction in regional VMT with the No-Build Alternative. The Phase 1 TSM Alternative would result in a regional VMT reduction of approximately 14,150 compared to the No-Build Alternative. The Phase 2 BRT Alternative would result in a regional VMT reduction of approximately 52,500 compared to a reduction of only 4,500 with the Phase 2 TSM. In Phase 3 the rail alternatives would all reduce regional VMT by more than 350,000 compared to a reduction of 8,100 with the Phase 3 TSM. As shown in Table 8-3, Alternative A2 achieves the greatest reduction in regional VMT among the Phase 3 rail alternatives.

8.2.6 Auto Person Trips Change

Reducing the number of auto person trips in the region is important to achieving the overall goal of reducing the negative environmental impacts of automobile use in the congested Corridor. The Phase 1 TSM Alternative would result in 3,700 fewer regional auto person trips per day in the year 2003 compared to the No-Build Alternative. These trips would be attracted from the automobile mode to the transit mode, most of which would be within the areas served by the new and improved Phase 1 TSM bus routes. The Phase 2 BRT Alternative would reduce regional auto person trips by 13,150 per day compared to a reduction of only 1,100 if the Phase 1 TSM were to continue in operation. The Phase 3 rail alternatives are projected to achieve a reduction in auto person trips of 37,900 (Alternative A1); 38,700 (Alternative A2); and 39,050 (Alternative B) compared to a reduction of 2,000 projected for the Phase 3 TSM Alternative. The

8.3 Land Use and Economic Development

Early in the study process, the Compact communities were asked to identify the locations where they desired and expected development to occur. Figure 6-5 illustrates these 77 economic target zones. The Urban Ring Phase 3 rail alternatives (TSM + BRT + Rail) would improve transit access to approximately 85 percent of these areas, as measured by the proximity of Urban Ring stations to those target areas. The Phase 2 BRT Alternative provides comparable geographic coverage, and the Phase 1 TSM provides somewhat less coverage. The No-Build Alternative would leave many of these economic development

target areas without transportation infrastructure sufficient to support growth in emerging areas, or to mitigate traffic impacts in the established areas experiencing growth pressure. Aside from the larger station catchment area³ assumed for rail compared to BRT, there is relatively little difference among the Phase 3 Alternatives in their ability to service economic target areas, or in the demographics around the proposed station locations.

Employment and population served are similar for all the Alternatives. Alternative B shows totals somewhat higher than Alternatives A1 and A2 primarily because it takes a longer route covering a larger geographic area. Nevertheless, the demographics are all within 5 percent of each other for the three alternatives. The residential population around the Urban Ring stations is 52 percent minority and contains large numbers of low income households and households without automobiles.

The No-Build Alternative and the Phase 2 and Phase 3 TSM Alternatives do not support local and regional land use and economic development objectives in the Corridor as well as the Phase 2 BRT and Phase 3 rail alternatives. The Urban Ring Compact jurisdictions believe that growth within certain areas of the Corridor is likely to exceed the forecasts presented above which were prepared within Regional control totals and are assumed in the 2025 "No Build" condition. The Urban Ring Compact has prepared a separate report addressing in greater detail its vision of the relationship between the transportation alternatives and land use and economic development within the Corridor.

8.4 Costs

8.4.1 Capital Costs

All costs are expressed in 2001 constant dollars exclusive of debt service. The magnitude capital costs of the alternatives with a 50 percent contingency on construction and including design and construction management, administration and insurance are summarized below. The capital costs shown for each phase are additive to the previous phase as shown in the cumulative column below. The Phase 1 and Phase 2 costs are common to each of the Phase 3 alternatives.

	<u>Phase</u>	<u>Cumulative</u>
Phase 1:	\$100 million	\$100 million
Phase 2:	\$500 million	\$600 million
Phase 3A1:	\$2.3 billion	\$2.9 billion
Phase 3A2:	\$2.2 billion	\$2.8 billion
Phase 3B:	\$2.2 billion	\$2.9 billion

Operation and Maintenance Costs

The Central Transportation Planning Staff (CTPS) prepared operating statistics for the final alternatives in May 2001. An estimate of the number of days that each transit mode will operate in the Urban Ring in a standard year was taken from the MBTA's 1998 National Transit Database along with the cost model factors for each transit mode. Cost model factors were then applied to the operating statistics, and estimated annual operating and maintenance costs were developed. The total annual operating costs of the Alternatives at the full implementation of each Phase are shown below in Year 2001 constant dollars. For Phase 2 and 3 a breakdown of the O&M cost by mode is shown in parentheses.

Phase 1:	\$23 million/yr.
Phase 2:	\$31 million/yr. (\$10.5M bus + \$20.5M BRT = \$31M)
Phase 3A1:	\$56 million/yr. (\$14M bus + \$19M BRT + \$23M LRT = \$56M)
Phase 3A2:	\$55 million/yr. (\$14M bus + \$19M BRT + \$22M Heavy Rail = \$55M)
Phase 3B:	\$56 million/yr. (\$12M bus + \$19M BRT + \$25M LRT = \$56M)

³ Demographic totals based on catchment area of 1/2-mile radius around LRT stations and 1/3-mile radius around BRT stations, which is based on guidelines established by CTPS to reflect the typical distance a transit user is willing to walk to reach a station.

Due to the significant capital, operating, maintenance, and debt service costs associated with the Final Alternatives, as well as the competitive environment for federal and state funding, the MIS has begun to examine a wide range of innovative funding concepts for possible application to the Urban Ring. The examination of innovative funding mechanisms for Phases 2 and 3 will continue following the MIS Final Report. Cost effectiveness indices for each of the phases will be determined during the DEIR/DEIS process, using the new Federal Transit Administration formulas that are expected to become available in September 2001.

8.5 Phasing and Implementation

The Urban Ring alternatives exhibit very good phasing characteristics because they can be built incrementally over time, the phases are separable, and the choices in Phases 1 and 2 can be made while retaining the flexibility to choose any of the Phase 3 rail transit alternatives. Phase 1 is the easiest to implement because it is low cost and involves no new right-of-way or technology. In Phase 1, two of the new CT bus routes show very strong ridership demand and could be considered for early phased implementation. Those routes are:

- CT5 Logan Airport to Sullivan Square (6,360 riders per day)
- CT7 Kendall Square to Franklin Park Zoo (4,940 riders per day)

During Phase 1 implementation of the new and improved CT and EC bus routes are expected to occur within the established MBTA service planning cycle without the need for an environmental process, though new funding will be required to procure vehicles and to provide for operations and maintenance associated with the new routes. Phase 2, which involves construction of new transportation facilities, modification of existing facilities, and implementation of major new transportation services, will be subject to a coordinated state and federal environmental review process. Sometime following implementation of the Phase 2 Urban Ring services a coordinated state and federal environmental process will be conducted for Phase 3 of the Urban Ring during which a determination on the preferred alignment and technology would be made.

Table 8-1
Phase 1 – Evaluation Summary

Criteria	TSM ¹
Transportation	
Accessibility	
• Travel Time Savings	3,870 hrs.
• Average Daily	
• Systemwide Transfers	+150/day
• Network Connectivity	Fair
Daily Ridership	
• Urban Ring Total	40,300
• Systemwide Change	+6,600
• Mode Share Change	+0.04
Transit System Efficiency	Good
Transit Congestion Relief	Good
Access for Mobility Impaired	Good
Non-Motorized Access	Good
Environment	
Air Quality Improvement	Good
Noise/Vibration/EMF Impact	Low
Wetlands Impact	None
Low Income/Minority Access	Good
Daily VMT Change	-14,150
Auto Person Trips Change	-3,700
Land Use/Economic Development	
Consistency with Local, State, Regional & Federal Goals	Good
Urban Fabric Benefits	Fair
Transit Supportive Land Use	Fair
Transit Supportive Economics	Fair
Cost²	
Capital Costs	\$100 M
O & M Costs	\$23 M/yr.
Implementation and Phasing Characteristics	Excellent

¹ All comparisons are to the 2003 No-Build Alternative.

² Capital and O&M costs shown are exclusive of debt service and are in 2001 constant dollars. O&M costs are based on full implementation of all proposed Phase 1 CT and EC routes. However, not all Phase 1 routes would be implemented by 2003.

Table 8-2
Phase 2 – Evaluation Summary

Criteria	Alternatives ¹	
	TSM ²	BRT ³
Transportation Accessibility - Travel Time Savings Average Daily - Systemwide Transfers - Network Connectivity Daily Ridership - Urban Ring Total - Systemwide Change - Mode Share Change Transit System Efficiency Transit Congestion Relief Access for Mobility Impaired Non-Motorized Access	1,404 hrs. -1,000/day Fair 45,550 +1,850 +0.01 Good Good Good Good	17,117 hrs. -7,550/day Very Good 106,000 +15,000 +0.09 Very Good Good Very Good Good
Environment Air Quality Improvement Noise/Vibration/EMF Impact Wetlands Impact Low Income/Minority Access Daily VMT Change Auto Person Trips Change	Good Low None Good -4,500 -1,100	Very Good Medium Medium Very Good -52,500 -13,150
Land Use/Economic Development Consistency with Local, State, Regional & Federal Goals Urban Fabric Benefits Transit Supportive Land Use Transit Supportive Economics	Good Fair Fair Fair	Very Good Very Good Very Good Very Good
Cost ⁴ Capital Costs O & M Costs	\$0 \$23 M/yr.	\$500 M \$32 M/yr.
Implementation and Phasing Characteristics	Excellent	Very Good

¹ All comparisons are to the 2010 No-Build Alternative.

² The alternative consists of the Phase 1 alternative in 2010.

³ The BRT alternative consists of BRT + Supporting Elements + non-redundant Phase 1 TSM combined in 2010.

⁴ Capital and O&M costs shown are exclusive of debt service and are in 2001 constant dollars. O&M costs for the BRT alternative are based on full implementation of all Phase 2 BRT routes and includes operation of non-redundant TSM bus routes. There is no capital cost for TSM buses in Phase 2 because they were purchased in Phase 1.

Table 8-3
Phase 3 – Evaluation Summary

Criteria	Alternatives ¹			
	TSM ²	A1 ³	A2	B
Transportation				
Accessibility				
• Travel Time Savings Average Daily	2,829 hrs.	49,186 hrs.	51,186 hrs.	50,217 hrs.
• Systemwide Transfers	+7,250/day	+45,700/day	+63,050/day	+51,000/day
• Network Connectivity	Fair	Excellent	Excellent	Excellent
Daily Ridership				
• Urban Ring Total	49,650	282,500	289,350	293,800
• Systemwide Change	+5,500	+46,500	+46,400	+47,650
• Mode Share Change	+0.04	+0.27	+0.27	+0.28
Transit System Efficiency	Good	Excellent	Excellent	Excellent
Transit Congestion Relief	Good	Excellent	Excellent	Excellent
Access for Mobility Impaired	Good	Very Good	Excellent	Very Good
Non-Motorized Access	Good	Excellent	Excellent	Excellent
Environment				
Air Quality Improvement	Good	Excellent	Excellent	Excellent
Noise/Vibration/EMF Impact	None	Medium	Medium	High
Wetlands Impact	Low	Low	Low	Low
Low Income/Minority Access	Good	Very Good	Very Good	Very Good
Daily VMT Change	-8,100	-355,200	-384,200	-369,600
Auto Person Trips Change	-2,000	-37,900	-38,700	-39,050
Land Use/Economic Devel.				
Consistency with Local, State, Regional & Federal Goals	Good	Excellent	Excellent	Excellent
Urban Fabric Benefits	Fair	Excellent	Excellent	Excellent
Transit Supportive Land Use	Fair	Excellent	Excellent	Excellent
Transit Supportive Economics	Fair	Excellent	Excellent	Excellent
Cost ⁴				
Capital Costs	\$0	\$2.3 B	\$2.2 B	\$2.2 B
O & M Costs	\$23 M/yr.	\$56 M/yr.	\$55 M/yr.	\$56 M/yr.
Implementation and Phasing Characteristics	Excellent	Good	Good	Good

¹ All comparisons are to the 2025 No-Build Alternative.

² The alternative consists of the Phase 1 alternative in 2025.

³ Alternatives A1, A2, and B service consist of Rail Transit + non-redundant BRT and TSM combined in 2025.

⁴ Capital and O&M costs shown are exclusive of debt service and are in 2001 constant dollars. O&M costs for A1, A2, B are based on full implementation of all Phase 3 rail transit routes and includes operation of non-redundant TSM and BRT routes. Capital cost is rail only. O&M costs for the TSM alternative are for buses only.

Chapter 9

NEXT STEPS

9.0 NEXT STEPS

The following steps are planned to take place following completion of the Major Investment Study (MIS) of circumferential transportation improvements in the Urban Ring Corridor and the concurrent filing of the Expanded Environmental Notification Form (ENF). Many of the steps in each phase will overlap steps in other phases and need to run concurrently in order to achieve implementation within the target timeframes. The steps outlined for Phase 1 and Phase 2 start with completion of the MIS. The Phase 3 steps would start in mid-2003.

Phase 1

- Prioritize the recommended bus routes;
- Secure funding to procure rolling stock and cover operating costs;
- Define and establish necessary bus maintenance facility modifications;
- Start service on Urban Ring Phase 1 bus routes.

Phase 2

- Conduct a coordinated State and Federal scoping session for DEIR/S;
- Complete the DEIR/S;
- Submit New Starts application to FTA;
- Complete FEIS and preliminary engineering;
- Design busways and other facilities;
- Procure and test the BRT rolling stock and systems;
- Construct facilities;
- Start service on Phase 2 Urban Ring BRT routes.

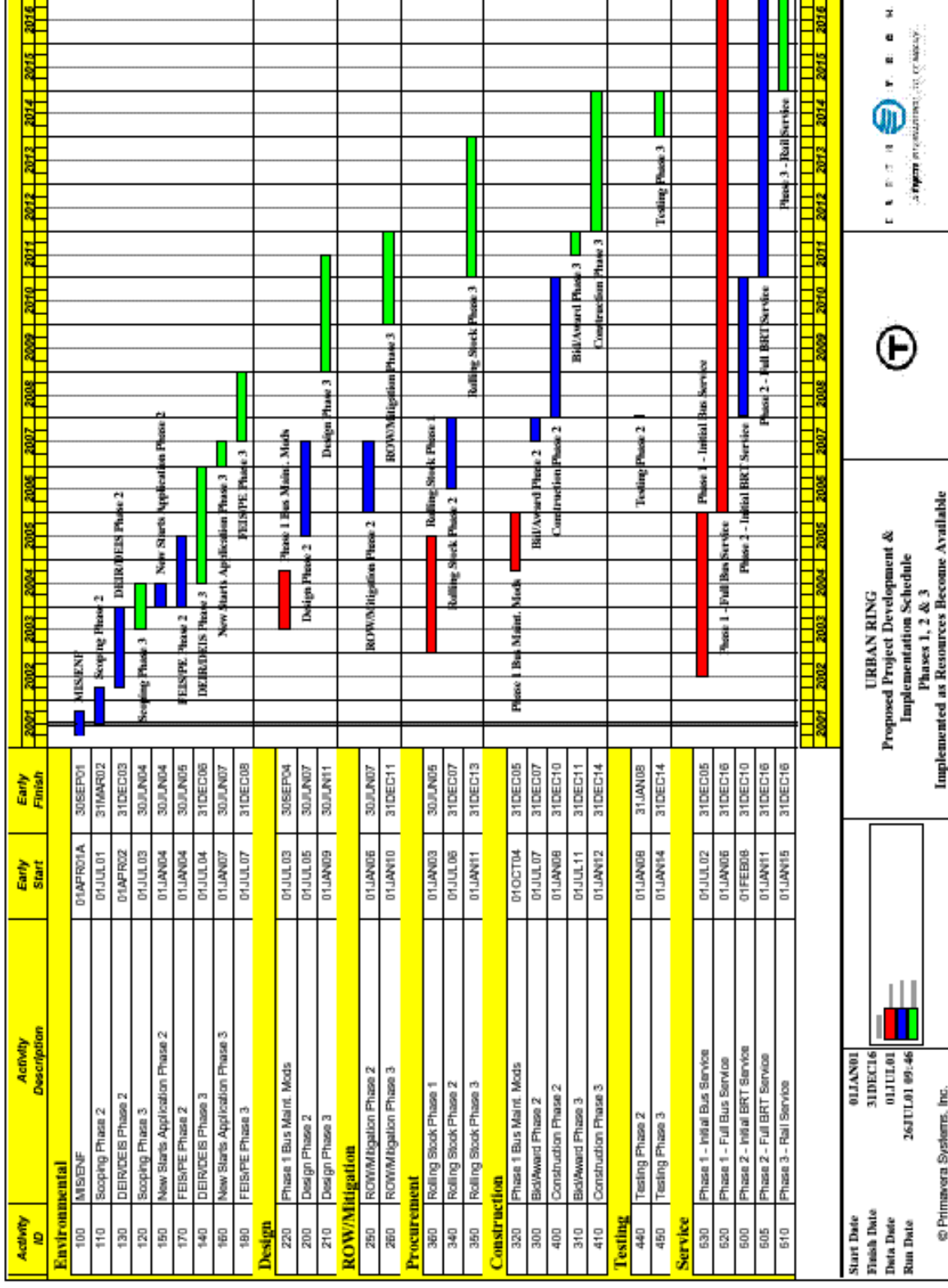
Phase 3

- Conduct a coordinated State and Federal scoping session for DEIS/R;
- Complete the DEIR/S;
- Submit New Starts application to FTA;
- Complete the FEIS and preliminary engineering;
- Design the rail system and related facilities;
- Procure and test the rail rolling stock and systems;
- Construct facilities;
- Start Phase 3 Urban Ring rail service.

Figure 9-1 contains a bar chart schedule showing the major steps in each phase of the project. This schedule is also included in the Expanded ENF document referred to above.

It is anticipated that the Compact municipalities and other project stakeholders that were instrumental in supporting the project through the MIS will continue to be active participants as the project moves forward through the general steps outlined above.

Figure 9-1
Proposed Project Development and Implementation Schedule



Appendix A

**GLOSSARY
AND
ABBREVIATIONS**

Glossary and Abbreviations¹

Definition of Terms

Accessibility – 1. A measure of the ability or ease of all people to travel among various origins and destinations. 2. In transportation modeling and planning, the sum of the travel times from one zone to all other zones in a region, weighted by the relative attractiveness of the destination zones involved - a.k.a. an accessibility index. 3. In traffic assignment, a measure of the relative access of an area or zone to population, employment opportunities, community services, utilities.

Activity Center – land use nodes within the Urban Ring study Corridor at which there is an existing or potential concentration of one or more land uses that would generate a substantial number of trips. Large transient population and heavy traffic volumes and densities characterize activity centers.

Alignment – the horizontal and vertical geometric elements, which define the location of the rail tracks, busway or roadway.

Ambient air quality – a physical and chemical measure of the concentration of various chemicals in the outside air, usually determined over a specific time period; for example, five minutes, one hour or one day.

At-grade Crossing – any intersection of two or more flows of traffic at the same elevation, possibly involving more than one mode of transportation, such as at a light rail crossing of a roadway.

Base period (off-peak period) – in transit, the time of day during which vehicle requirements and schedules are not influenced by peak-period passenger volume demands (e.g. between morning and afternoon peak periods). At this time, transit riding is fairly constant and usually low to moderate in volume when compared with peak-period travel.

Boston Transportation Planning Review – the landmark 1972 study that articulated the characteristics of an expanded Boston Core area linked by a circumferential transit Corridor.

Buses - A mode of transit consisting of rubber-tire high occupancy vehicles operating in various environments.

Buses in Mixed Traffic: an operating environment where the bus is sharing the travel lane(s) with regular automobile traffic. It could incorporate passenger information systems and Intelligent Transportation System (ITS) features.

Reserved Bus Lane: a lane or lanes on urban streets or freeways reserved for bus use only, separated from other lanes by pavement markings, signs or rubber cones, but not by fixed physical barriers. It typically includes passenger information systems and ITS features.

Busway: a roadway primarily reserved for buses, shared in some locations with commercial vehicles. It typically includes passenger information systems and ITS features.

Bus lane – a traffic lane for dominant or exclusive use by buses.

¹ The Material contained in this section has been drawn from a number of sources including:

Glossary - Urban Public Transportation, Transportation Research Board (TRB), National Research Council, Washington DC, 1989
Transportation Glossary, American Association of State Highway and Transportation Officials (AASHTO), Washington DC, 1983
Draft Environmental Impact Statement, Central Link Light Rail Transit Project, Sound Transit, Seattle, WA, December 1998

Bus Rapid Transit (BRT) System - generally understood to be a combination of advanced technologies and operating environments offering many of the *advantages* of a subway system without the associated high capital cost. BRT systems include some or all of the following features: bus priority, separation from traffic, visibility (except for short tunnel segments to avoid traffic congestion), faster passenger boarding, faster fare collection, higher capacity, passenger friendly information systems, and an image that is uniquely identifiable. The Urban Ring BRT system would use 60' long, articulated, low floor vehicles with low emission propulsion systems. The Urban Ring BRT would incorporate passenger information systems and a variety of ITS features to provide greater reliability and schedule adherence. The Urban Ring BRT vehicles would operate over routes using a combination of buses in mixed traffic, bus lanes, and busways. The planned MBTA Silver Line is an example of a BRT system.

Calibration – 1.reconciliation of an instrument with an established standard. 2. In modeling, the procedure used to estimate the parameters of a model or to adjust a model to replicate actually measured conditions.

Capacity - there are two types of capacity - static and dynamic. Static capacity is the total number of persons a vehicle can accommodate. Dynamic capacity is the maximum number of vehicles, spaces or persons that can be transported past a fix point in one direction per unit of time (usually one hour).

Capital Costs – non-recurring costs to construct transit systems, including the costs of right-of-way, facilities, rolling stock (i.e. vehicles), power distribution, the associated administrative and design costs, and debt service during construction. Urban Ring capital costs shown in the Progress Report are exclusive of debt service at this time because the phasing schedule, which determines debt service, has not yet been determined.

Circumferential Transportation – a transportation service or system within the circumference of the generally circular Urban Ring Corridor. The term generally refers to possible Urban Ring service routes that would form a “rim” connecting the various “spokes” made up of the numerous radial transit lines that converge on the “Hub” in downtown Boston.

Commuter Rail - A regional passenger service consisting of electric or diesel-powered trains on grade-separated railroad lines (sometimes with protected grade crossings). The MBTA Commuter Rail system serves North and South Stations.

Commuter transit – transit services (rail or express bus) operated during peak hours only, primarily serving work trips.

Conformity – meeting a State Implementation Plan (SIP) purpose of eliminating or reducing the severity and number of violations of the NAAQS and achieving expeditious attainment of those standards.

Conventional Bus System - existing local, express, and limited stop routes typically utilizing 40' vehicles. The MBTA operates conventional bus routes mostly in mixed traffic, except in areas such as the Harvard Square Bus Tunnel, the Davis Square Busway, and along the zipper lane on the Southeast Expressway.

Corridor (Urban Ring Study Corridor) – is the geographic area approximately one mile wide and fifteen miles long that encircles the Inner Core of Boston and is the focus of analysis in the Urban Ring Major Investment Study.

Corridor subarea – an aggregation of traffic analysis zones at the subzone level using the CTPS 986 zone system. The Urban Ring Corridor is comprised of 20 Corridor subareas plus South Boston, which was added to the Corridor during the MIS. The Corridor subarea aggregations were used

to analyze and report on baseline and projected Urban Ring population, employment and other demographics, as well as economic indicators such as floorspace.

Cost-effectiveness analysis (CEA) – an analytical technique used to choose the most effective method for achieving a program or policy goal. The costs of alternatives are measured by their requisite estimated monetary expenditures. Effectiveness is defined by the degree of goal attainment and may also (but not necessarily) be measured in monetary terms.

Equity – in transportation, a normative measure of fairness among transportation users.

Future design year – the year for which traffic projections have been made and transportation needs analyzed.

Feeder Service – local transit service (typically buses) that feed ridership to faster, higher capacity transit services.

Grade-separated – parallel or crossing lines of traffic that are vertically or horizontally physically separated from each other and do not share a common intersection.

Grand Junction Railroad – an active rail line controlled by CSX, a rail freight company, extending from the Allston rail yard in Boston across the Charles River beneath the Boston University Bridge, through Cambridgeport, the MIT campus, East Cambridge, and terminating in the vicinity of the Somerville rail yards. It is primarily used as an access route for MBTA south system commuter rail equipment to reach the MBTA maintenance facility in Somerville. There is no passenger service currently on this line. The line represents a candidate right-of-way for Urban Ring service.

Headway – the time between transit vehicles at any particular point along the route.

Heavy Rail Transit - A mode of transit consisting of high platform vehicles with steel wheels travelling on steel tracks powered by electricity from either a third rail or overhead wires. When powered by a third rail, such as the MBTA Orange and Red Lines, a Rail Rapid Transit system must operate on a 100% grade separated exclusive right-of-way. The MBTA Blue Line draws power from both overhead wires and a third rail. The Urban Ring Rail Rapid Transit system would operate as a new branch of the Orange Line.

High Occupancy Vehicle (HOV) – typically includes carpools with two or more persons, vanpools and buses.

Induced trips – trips generated because of the construction of a new transportation facility. All ridership projections presented in the MIS Progress Report are exclusive of any induced trips, consistent with FTA requirements. Urban Ring ridership forecasts represent baseline trips in the region that would be shifted away from other transit lines and the automobile due to the superior.

Inner Belt Highway – an interstate highway extension planned in the 1950's and 1960's that would have extended a new limited access expressway through portions of Boston, Brookline, Cambridge and Somerville. The project was abandoned in the 1970's primarily due to community opposition. Portions of the former planned highway represent candidate right-of-way for Urban Ring service.

Inner Core (Boston Inner Core) – the area surrounded by, but not included in, the Study Corridor. The Inner Core consists primarily of downtown Boston.

Level of Service (LOS,L/S) – 1. A set of characteristic that indicate the quality and quantity of transportation service provided, including characteristics that are quantifiable (system performance, e.g. frequency, travel time, travel cost, number of transfers, safety) and those that are difficult to quantify (service quality, e.g., availability, comfort, convenience, modal image). 2.

For highway systems, a qualitative rating of the effectiveness of a highway or highway facility in serving traffic, in terms of operating conditions. The Highway Capacity Manual identifies operating conditions ranging from A, for best operations (low volume, high speed), to F, for worst conditions. 3. For paratransit, a variety of measure meant to denote the quality of service provided, generally in terms of total travel time or a specific component of total travel time. 4. For pedestrians, sets of area occupancy classifications to connect the design of pedestrian facilities with levels of service (A for best through F for worst).

Light Rail Transit (LRT) – A mode of transit consisting of low floor vehicles with steel wheels travelling on steel tracks powered by electricity from overhead wires. The Urban Ring Light Rail system would operate in both at-grade and/or grade separated environments. The existing MBTA Green Line is an example of a Light Rail system.

Link – in planning, a section of a transportation system network defined by intersection points (nodes) at each end; that is, a link connects two nodes. It may be one-way or two-way.

Load Factor – 1. The ratio of used capacity to offered capacity of equipment or facility during a specified time period. It is usually expressed as a percentage of seats occupied at a given point or (in continuous form) passenger miles (kilometer) per train mile (kilometer) to account for the ability to couple rail cars together to achieve efficiency. 2. The ratio of passengers actually carried versus the total passenger capacity of a vehicle; also known as a utilization coefficient.

Mass transportation – transportation by bus, rail, boat or other conveyance, either publicly or privately owned, that provides general or special service to the public on a regular and continuing basis (not including school bus, charter or sightseeing service).

Modal split (mode split) – 1. The proportion of total person trips that uses each of various specified modes of transportation. 2. The process of separating total person trips into the travel used. 3. A term that describes how many people use alternative forms of transportation. It is frequently used to describe the percentage of people who use private automobiles, as opposed to the percentage who use public transportation.

Mode – a particular form of travel, for example, walking, travelling by automobile, travelling by bus, travelling by train.

Model – 1. A mathematical or conceptual presentation of relationships and actions within a system. It is used for analysis of the system or its evaluation under various conditions; examples include land use, economic, socioeconomic, transportation. 2. A mathematical description of a real life situation that used data on past and present conditions to make a projection about the future.

Network – 1. In planning, a system of links and nodes that describe a transportation system. 2. In highway engineering, the configuration of highways that constitutes the total system. 3. In transit operations, a system of transit lines or routes, usually designed for coordination operation.

Operating Costs – recurring costs incurred in operating transit systems, including wages and salaries, maintenance of facilities and equipment, fuel, supplies, employee benefits, insurance, taxes, and other administrative costs. Amortization of facilities and equipment is not included.

Park-and-Ride (P&R) – a term applied to a passenger who drives to a transit station and parks his/her automobile in the station's P&R lot. Possible with any transit mode, but most commonly used with rail modes, particularly RPT and RGR.

Passenger miles (passenger kilometers) - the transportation of one passenger a distance of one mile (kilometer).

Passenger mile per train mile (passenger kilometers per train kilometer) – the number of passenger miles (kilometers) accomplished by a given train miles (kilometers) and seat miles (kilometers) provides a measure of transit system efficiency.

Peak hour – the hour of the day in which the maximum demand for service is experienced, accommodating the largest number of automobiles or transit patrons.

Peak period – a specified time period for which the volume of traffic is greater than that during other similar periods.

Performance (Transit System) – a composite measure of transit system operating characteristics, mostly quantitative, such as service frequency, speed, reliability, safety, capacity and productivity.

Program for Mass Transportation – is the mass transportation plan for the Boston metropolitan area. According to M.G.L. chapter 161A, section 5 (g) it is “a long range plan for the construction, reconstruction or alteration of facilities for mass transportation within the area constituting the Authority (MBTA) together with a schedule for the implementation of such plan and comprehensive financial estimates of costs and revenues.”

Public Transportation – transportation service to the public on a regular basis using vehicles that transport more than one person for compensation, usually but not exclusively over a set route or routes from one fixed point to another. Routes and schedules of this service may be predetermined through a cooperative arrangement. Subcategories include public transit service and paratransit services that are available to the general public.

Rail Transit – a term applied to describe a transit service involving steel wheels on steel rails. The major services, generally in ascending order of performance, are streetcars, light rail transit, rail rapid transit, commuter rail and regional rail.

Rapid Transit – a generic class of transit modes which operate exclusively on a R/W category "A" and have high speed, capacity, reliability and safety, including, but not limited to RRT, RTR, LIRRT and most RGR systems.

Regional Planning Compact – an agreement signed by the chief executive officers of Boston, Brookline, Cambridge, Chelsea, Everett and Somerville in October 1995 committing them to a direct role in the Urban Ring MIS and to work together to coordinate local land use and economic development planning with transportation planning.

Regional Rail (RGR) or Commuter rail – a regional passenger service, usually provided by railroad agencies, which consists of electric or diesel-powered trains or grade-separated railroad lines (sometime with protected grade crossings).

Regional Transit – a term used to describe either long bus or rail transit lines with few stations and high operating speeds. They primarily serve long trips within metropolitan regions, as distinguished from city transit and short-haul transit.

Regular Bus (RB) or Local Services – common urban bus routes serving all stops, as distinguished from short-haul and express service.

Regular Bus Lane (RBL) – a lane or lanes on urban streets or freeways reserved for bus use only, separated from other lanes by pavement markings, signs or rubber cones, but not by fixed physical barriers.

Right-Of-Way (ROW, R/W) – a general term denoting land, property, or interest therein, usually in a strip, acquired for or devoted to transportation purposes.

Signal Preemption – traffic signal options that may modify normal traffic signal phasing to provide preferential treatment of transit vehicles through at-grade intersections.

Signal Priority – traffic signal options that work within the normal traffic signal phasing to enable a transit vehicle to extend the green phase when approaching at-grade intersections.

Traffic Analysis Zone (TAZ) – standardized geographic subdivision at which travel data is collected, organized, and analyzed. TAZ boundaries are standardized by CTPS, which transitioned from a 787 zone system to a 986 zone system during the course of the MIS.

Traffic Zone Grouping – aggregation of traffic analysis zones using the CTPS 787 zone system. The Urban Ring Corridor is comprised of seventeen Traffic Zone Groupings plus South Boston, which was added to the Corridor during the MIS. The Traffic Zone Groupings were used to conduct the travel market analysis in the Corridor.

TEA-21 – is the Transportation Equity Act for the 21st Century. It is an omnibus federal transportation law that includes requirements for the Federal Transit Administration to establish a methodology to evaluate, rate, and recommend funding for proposed New Starts projects seeking Section 5309 New Starts funds for new or extended fixed guideway systems.

Transportation disadvantaged (low-mobility group) – people whose range of transportation alternatives is limited, especially in the availability of relatively easy-to-use and inexpensive alternatives for trip making. Examples include the young, the elderly, the poor, the handicapped, and those who do not have automobiles.

Transportation System Management (TSM) – the Urban Ring TSM option includes a variety of new and improved conventional bus routes and represents the best that can be done for mobility improvements using 40' vehicles and existing infrastructure, without constructing major new transportation facilities.

Trip – 1. A one-way movement of a person or vehicle between two points for a specific purpose; sometimes called a one-way trip to distinguish it from a round trip. 2. In rail operations, a mechanical lever or block signal that, when in the upright position, activates a train's emergency braking system. 3. The movement of a transit unit (vehicle or train) in one direction from the beginning of a route to the end of it; also known as a run.

Trip assignment (flow distribution, traffic assignment) – in planning, a process by which trips, described by mode, purpose, origin, destination and time of day, are allocated among the paths or routes in a network by one of a number of models.

Trip attractions – in planning, the number of trips, daily or for a specified time interval, to or from a zone generated by present or future land uses in that zone. The term normally refers to the non-home end of a trip. Trip attractions can also be defined as the non-home ends of a home based trips or the destinations of non-home based trips.

Trip productions – in planning, the number of trips, daily or for a specified time interval, that are produced from and return to a given zone, generally the zone of residence. Trip productions can also be defined as the home ends or home-based trip or the origin of non-home-based trips.

Urban public transportation – transport systems for intra-urban or intra-regional travel available for use by any person.

Abbreviations and Acronyms

AA	Alternative Analysis
AADT	Average Annual Daily Traffic
ABC	Artery Business Committee
ADT	Average Daily Traffic
AGT	Automated Guided Travel
BRA	Boston Redevelopment Authority
BRT	Bus Rapid Transit
BTPR	Boston Transportation Planning Review
CBD	Central Business District
CTEC	Circumferential Transit Employers' Coalition
CTPS	Central Transportation Planning Staff
DEIS	Draft Environment Impact Statement
E&H	Elderly and Handicapped
EIS	Environmental Impact Study
EOTC	Executive Office of Transportation and Construction
EPA	Environmental Protection Agency (U.S.)
FEIS	Final Environmental Impact Statement
FTA	Federal Transit Administration
FHWA	Federal Highway Administration
FONSI	Finding of No Significant Impact
IBOA	Independent Bus Operators Association
LOS, L/S	Level of Service
LPA	Locally Preferred Alternative
LRT	Light Rail Transit
LRV	Light Rail Vehicles
MAPC	Metropolitan Area Planning Council
MASCO	Medical and Scientific Community Organization
MBTA	Massachusetts Bay Transportation Authority
MIS	Major Investment Study
MM	Move Massachusetts
MPO	Metropolitan Planning Organization
NAAQS	National Ambient Air Quality Standard
NEPA	National Environmental Protection Act of 1969
NRHP	National Register of Historic Places
PMT	Program for Mass Transportation
PRT	Personal Rapid Transit
P&R	Park-and-Ride
ROW	Right-of-Way
SDEIS	Supplemental Draft Environmental Impact Statement
SIP	State [air quality improvement] Implementation Plan
SMSA	Standard Metropolitan Statistical Area
TAZ	Traffic Analysis Zone
TDP	Transit Development Program
TSM	Transportation Systems Management
VHT	Vehicle Hours of Travel
VMT	Vehicle Miles of Travel

Appendix B

COMMITTEES AND PREPARERS

**The following committees provided review of and direction to the
Urban Ring MIS:**

Steering Committee

Peter Calcaterra and Tom Nally Co-Chairs

Jay Ash	Todd Fontanella	Tom Nally
Joseph Blair	Marzie Galazka	Stephanie Pollack
Scott Darling	Richard Garver	Deborah Poodry
Ralph DeNisco	Sarah Hamilton	Susanne Rasmussen
John DePriest	Jeff Levine	Cara Seiderman
Robert Duffy	Penn Loh	Forrest Speck
Richard Easler	Vijay Mahal	

Public Participation Sub-Committee

Claire Barrett, Chair

Economic Development, Land Use and Zoning Sub-Committee

Richard Garver, Chair

Financing Options Sub-Committee

Joe Blair and Jay Ash Co-Chairs

Forecasting and Modeling Sub-Committee

Richard Easler, Chair

Options and Alternatives Sub-Committee

Sarah Hamilton, Chair

Operations and Users Sub-Committee

Forest Speck, Chair

MBTA Technical Advisory Committee

Anna Barry	Peter Calcaterra	Howard Haywood
Steve Berrang	David Carney	Anne Herzenberg
Eric Botterman	Alan Castaline	Michael Mulhern
Barbara Boylan	Joseph Cosgrove	Maureen Trainor
Andrew Brennan	Dennis DiZoglio	Steve Woelfel

Preparation of the Urban Ring MIS Document Involved the Combined Efforts of :

MBTA Planning Department

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Prime Consultant

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James A. Doyle, AICP, Project Manager

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Bevco Associates
Cambridge Economic Research
Cambridge Systematics, Inc.
Claire Barrett & Associates
Judith Nitsch Engineering, Inc.
KM Chng Environmental, Inc.
Parsons, Brinckerhoff, Quade & Douglas
Rizzo Associates
TAMS Consulting, Inc.

Central Transportation Planning Staff (CTPS)

Provided Travel Demand Forecasting and Demographic Data Use in the Report
Vijay Mahal, Project Manager

Appendix C

**LIST OF TECHNICAL MEMORANDA AND
RELATED REPORTS**

TECHNICAL MEMORANDA

Numerous technical memoranda were developed that document the research, analysis, findings and recommendations achieved throughout the MIS, particularly at key milestones in the planning process. Those technical memoranda often contain information more detailed or voluminous than can be contained in this MIS Progress Report. Provided below is a listing of the major technical memoranda that were developed.¹ The technical memoranda are organized within the following subject groupings for ease of reference. Within each grouping there may be multiple individual documents that were developed as the MIS progressed as indicated by the dates.

- Public Participation
- Baseline Conditions, Goals & Objectives, Evaluation Criteria & Methodologies
- Alternatives Definition
- Conceptual Engineering
- Costs
- Economic Development and Land Use
- Evaluation of the Alternatives
- Funding
- Other

Public Participation

Public and Agency Participation Plan, Claire Barrett & Associates, Inc., January 22, 1997.

Public Participation Program Documentation, Claire Barrett & Associates, Inc., June, 2001.

General Public Meeting Summaries and Minutes

Workshop Summaries and Minutes

Baseline Conditions, Goals & Objectives, Evaluation Criteria & Methodologies

Baseline Analysis, Purpose and Need Assessment, and Problem Definition, ICF Kaiser Engineers, Inc., April 30, 1997.

Goals, Objectives, Evaluation Criteria & Methodologies, ICF Kaiser Engineers, Inc., June 19, 1997.

Land Use and Urban Design Baseline, Comunitas, Inc., April 8, 1997.

Travel Demand & Land Use Coordination Plan, Cambridge Systematics, Inc., May 1, 1997.

Travel Market Analysis, Cambridge Systematics, Inc., May 7, 1997.

Alternatives Definition and Screening

Identification of Preliminary Alternatives, ICF Kaiser Engineers, Inc., August 11, 1997.

Conceptual Definition of the Alternatives, ICF Kaiser Engineers, Inc., December 13, 1997.

Detailed Definition of the Test Alternatives, ICF Kaiser Engineers, Inc., March 30, 1998.

¹ As listed in this Appendix the firm ICF Kaiser Engineers, Inc. is now Earth Tech, Inc.

Detailed Definition of the Evaluation Alternatives, ICK Kaiser Engineers, Inc., May 24, 1999.

Screening of Preliminary Alternatives, ICF Kaiser Engineers, Inc., August 19, 1997.

Operating Concepts, Earth Tech, Inc., March 20, 2001.

Conceptual Engineering

Conceptual Alignments, Profiles, Station Locations, and Typical Sections, ICF Kaiser Engineers, Inc., September 1998.

Focused Engineering Analysis, Earth Tech, Inc., May 31, 2001.

Conceptual Alignments, Profiles, Station Locations, and Typical Sections - Phase 3, Earth Tech, Inc., July 2001.

Costs

Capital Costs of the Test Alternatives, ICF Kaiser Engineers, Inc., March 24, 1998.

Capital Costs of the Evaluation Alternatives, ICF Kaiser Engineers, Inc., June 19, 1999.

Operations and Maintenance Costs of the Evaluation Alternatives, ICF Kaiser Engineers, Inc., August 24, 1999.

Operation and Maintenance Costs, Earth Tech, Inc. June 12, 2001.

Economic Development and Land Use

Analysis of Economic Development Factors, Cambridge Systematics, Inc., March 8, 1999.

Analysis of Economic Development Factors – Hybrid Alternatives (aka Evaluation Alternatives), Cambridge Systematics, Inc., August 31, 2000.

Analysis of Economic Development Factors - Alternatives A and B, Cambridge Systematics, Inc., June 15, 2001.

Land Use and Development Relationship – Station Concept Studies, Antonio DiMambro + Associates, June 29, 1998.

Evaluation of the Alternatives

Transportation Implications of the Test Alternatives, ICF Kaiser Engineers, Inc., January 30, 1999.

Transportation Implications of the Evaluation Alternatives, Kaiser Engineers, Inc., August 20, 1999.

Environmental Consequences of the Test Alternatives, Rizzo Associates, Inc., March 3, 1998.

Environmental Consequences of the Evaluation Alternatives, Rizzo Associates, Inc., July 7, 1999.

Environmental Consequences of the Evaluation Alternatives – Air Quality, Noise and Vibration, and Electromagnetic Field Impacts, Rizzo Associates, Inc., December 17, 1999.

Noise and Vibration Assessment Report (Draft), KM Chng Environmental Inc., July 6, 2001.

Estimation of Electromagnetic Interference (EMI) Generated by Urban Ring Transportation Technologies, Gradient Corp., July 6, 2001.

Funding

Innovative Funding Techniques, Cambridge Systematics, Inc., February 27, 1998.

Project Delivery Options – Innovative Financing Options, Calculation of Hypothetical Revenue Streams, Cambridge Systematics, Inc., August 31, 1999.

Other

MIS Final Report Executive Summary, Earth Tech, Inc., July 2001. The Executive Summary of the Urban Ring MIS Final Report was filed as an attachment to the Expanded Environmental Notification Form (ENF) for the Urban Ring Project.

RELATED REPORTS

Two close partners in the Urban Ring MIS process were the jurisdictions comprising the Urban Ring Compact, and the Central Transportation Planning Staff (CTPS). The Urban Ring Compact provided the forum to identify the land use and economic development priorities of the Corridor jurisdictions while CTPS, under contract to the MBTA, provided the ridership forecasting and demographic data used throughout the MIS.

In addition to providing day to day input and coordination to the Urban Ring MIS, these two groups also developed their own technical reports as listed below.

Urban Ring Compact

The Urban Ring Compact Report, Prepared by the member jurisdictions of Boston, Chelsea, Everett, Somerville, Cambridge, and Brookline, September 2000. (Updated version of the Compact Report expected to be available in August 2001)

Central Transportation Planning Staff

Ridership Forecasting Methodology – Urban Ring Major Investment Study, Vijay Mahal and Karl Quackenbush, CTPS, June 2000

Ridership, Forecasting Methodology – Urban Ring Final Alternatives, Vijay Mahal and Karl Quackenbush, CTPS, July 2001

Appendix D

RIGHT-OF-WAY PRESERVATION

RIGHT-OF-WAY PRESERVATION

This Appendix identifies and describes key right-of-way issues and, at a general level, the right-of-way requirements associated with the three Urban Ring Evaluation Alternatives. The material is intended to provide the MBTA, Urban Ring Compact jurisdictions and other public sector stakeholders with information needed to identify and consider Urban Ring right-of-way requirements within the local planning and decision making process. The information also highlights areas where loss of, or encroachment on, the right-of-way could preclude or negatively impact the Urban Ring alternatives as currently defined. Steps taken locally in the short-term to retain the preferred surface and subsurface rights-of-way are likely to have a beneficial impact on the long-term performance, constructability and costs of the Urban Ring project. Given that the Urban Ring is a long-range project likely to be implemented in stages over a 10- or 20-year period, and that the Corridor is projected to experience growth rates higher than the region as a whole, the case for taking such steps is compelling.

The information is organized within the five geographic segments comprising the Urban Ring Corridor, starting at the north end in Segment 1 and proceeding counterclockwise around to Segment 5. It must be noted that the identification of right-of-way requirements is, at the MIS level, preliminary and based on review of existing information provided to the Consultant Team. No field measurements or survey work was performed during the MIS and all information is subject to verification during subsequent, more detailed, phases of the Urban Ring project.

Information Sources

A variety of information sources were used to first identify the right-of-way requirements of the alternatives and, to the extent known, identify the owner(s) of the property. The information sources are summarized below.

Right-of-Way Requirements

Typical cross sections and 1"=200' scale plan and profile drawings were developed for each of the Urban Ring MIS alternatives. However, while they provide general guidance they are not designs. Preliminary engineering, with its site-specific consideration of conditions, does not occur until the DEIS stage of a project.

Property Ownership

Various sources were used, including assessor maps for Chelsea and Cambridge, railroad valuation maps and GIS maps from Transit Realty Associates for MBTA property, and the Mass Highway right-of-way inventory database. The completeness and accuracy of the information was not verified. No fieldwork was performed.

Technical Assumptions

Several assumptions were made regarding design parameters for the various transit modes in order for the team to establish a consistent set of dimensions critical to the station concept studies. These assumptions are listed in Appendix E.

Key Right-Of-Way Issues and Requirements by Segment

Key issues and general right-of-way requirements of the Urban Ring alternatives were identified in each of the five geographic segments shown in Figure D. The numbers shown on Figure D are keyed to the descriptions and discussion provided below. All issues and requirements pertain to the Urban Ring BRT Alternative (Phase 2), and Alternatives A1, A2, and B (Phase 3). There are no right-of-way issues or requirements associated with the CT and EC bus routes (Phase 1).

Segment 1 – East Boston, Chelsea, and Everett

I.D.# Description

1.1 Airport Blue Line Station, Boston

The new Airport Blue Line Station needs bus bays sufficient to accommodate Urban Ring BRT vehicles approaching from the north (from Chelsea) and from the south (Williams Tunnel and Logan Terminals). MBTA has made its needs known, and will continue to monitor and review throughout design and construction to ensure the facility can handle Urban Ring BRT vehicles.

[Early in the MIS when LRT was being considered for this segment, a tunnel envelope was identified for LRT access beneath this station and an underground easement identified. Refer to the January 5, 1998 memo from C. Schofield of the MBTA to M. Lewis of MHD/CA. Although rail is not currently planned within the Phase 3 timeframe preserving an easement for possible long-range rail access may be advisable]

1.2 Airport Service Road SR2, Boston

Similar to the station listed above, it is assumed that the Urban Ring BRT will be able to utilize this Service Road between the Airport Blue Line Station northward to a point in the vicinity of Lovell Street.

1.3 East Boston Truck Route, Boston

Near Lovell Street the Urban Ring BRT vehicles would turn off of SR2 and pass beneath the elevated Route 1A and operate over the East Boston Truck Route. It is believed that the right-of-way in this segment is currently a combination of Massport, MHD, City of Boston, and Conrail (CSX) property See Figures D-1 and D-2). Upon reaching the west side of Route 1A there are a number of right-of-way alignment issues critical to implementation of BRT service, including:

- Coordination with the East Boston Greenway in the southwest corner of Neptune Road and Route 1A.
- Coordination with the North Shore MIS that may consider extending a branch of the Blue Line north along this corridor.

Currently, it is assumed that others will build the East Boston Truck Route prior to the Urban Ring, and that the Urban Ring BRT will be allowed to operate over it.

1.4 New Chelsea Creek Lift Bridge, Boston

The City of Boston is designing a replacement for the existing drawbridge across Chelsea Creek. It is believed that the new vehicular Lift Bridge will be in the same alignment as the existing drawbridge. It is assumed that the East Boston Truck Route, over which the Urban Ring BRT would operate, will tie into mixed traffic to cross over this new bridge. It is critical that the design of the new Lift Bridge accommodates this tie-in of the East Boston Truck Route/Urban Ring BRT Route on both sides of Chelsea Creek.

Although not an issue within the current planning horizon, the location of the new lift bridge in the same alignment as the existing draw bridge would make placement of a fixed rail bridge for the Urban Ring at this location very difficult if the BRT were to be upgraded to a fixed rail system in the long-range.

1.5 Massport Employee Parking Garage/Waterfront BRT Station Site, Chelsea

Land should be reserved for a BRT station at the northwest corner of Eastern Avenue and Central Avenue in Chelsea. This location is adjacent to the existing Massport employee-parking garage. The assessor maps from City of Chelsea indicate this property is owned by "Railroad" but it does not identify the name of the company.

1.6 Abandoned Railroad Right-Of-Way, Chelsea

This entire length of abandoned freight railroad right-of-way approximately 3,200' long would be needed between Eastern Avenue and Broadway. The abandoned right-of-way varies in width from about 30' to about 150' wide. The BRT busway would only need about 30' width along the entire length, though the wider areas might be needed long-term for maintenance and storage of vehicles. Figure D-3 shows this area.

1.7 MBTA Right-of-Way Broadway to Everett Avenue, Chelsea

Between Broadway and Everett Avenue in Chelsea, the BRT would need a right-of-way approximately 30' wide and 2,600' long adjacent to the south side of the MBTA Newburyport-Rockport Commuter Rail Line. This segment includes the existing Chelsea Commuter Rail Station and crosses under or across several roadways, including Broadway, Washington Avenue, Arlington Street, Sixth Street, Route 1, Spruce Street and Everett Avenue. See Figures D-4 through D-6.

1.8 Everett Avenue/Mystic Mall BRT Station, Chelsea

This new BRT station would be located between Spruce Street and Everett Avenue in an area of Chelsea undergoing redevelopment. The conceptual configuration and approximate dimensions of this BRT station are shown in the station concept panel developed for this site.

1.9 Revere Beach Parkway BRT Station, Chelsea/Everett

This BRT station stop would be near the corner of Revere Beach Parkway and Everett Avenue in an area where the BRT would be operating in mixed traffic (see Figure D-7). However, given the short headways and substantial projected ridership at this station (approx. 4,500/day), the BRT station stop should be located out of the main flow of traffic. Land will be needed for the BRT station on both sides of the either Revere Beach Parkway or Everett Avenue.

1.10 MBTA Right-Of-Way Everett Avenue to Route 99, Chelsea and Everett

This segment of the BRT alignment is a continuation of the exclusive busway described in Item 1.7 adjacent to the south side of the Newburyport-Rockport Commuter Rail Line. This segment would be approximately 5,800' long and 30' wide, and would need to include land for a BRT station at the corner of Second Street. See Figures D-8 and D-9.

1.11 Second Street Station on Revere Beach Parkway, Everett

Similar to Item 1.9, the BRT station along Revere Beach Parkway will need to be located out of the main flow of traffic at a location near the intersection with Second Street in Revere.

1.12 Second Street Station on Revere Beach Parkway, Everett

The BRT will operate in mixed traffic through Santilli Circle in Phase 2. In Phase 3 an exclusive busway would connect from the commuter rail corridor to Santilli Circle.

1.13 Wellington Station BRT Access and Loading Area

Urban Ring BRT buses need expedited access in and out of Wellington Station and an area to handle what is projected to be over 8,000 daily boardings, with convenient transfers to and from the Orange Line.

Segment 2 – Somerville, Cambridge

2.1 Assembly Square/Yard 21, Somerville

Previous Urban Ring alternatives included a separate Assembly Square Urban Ring LRT station and tail tracks located in what is referred to as "Yard 21." See Figures D-12 through D-14. However, the City of Somerville indicated that it was acquiring that property for development purposes and requested that the Urban Ring station be moved south and combined with an extended Sullivan Square station. It was also suggested that the Urban Ring LRT tail tracks be

located on the MBTA property near the Charlestown bus maintenance facility or further south along the lead tracks rather than within Assembly Square. Despite these changes, it may be advisable to preserve a linear corridor adjacent to the west side of the existing Orange Line tracks through the full length of Assembly Square to enable the relocation of tracks, crossovers, and signals necessary to implement an Assembly Square Orange Line station and a commuter rail station at Sullivan Square. South of Sullivan Square station there are existing commuter rail tracks and the Orange Line viaduct that may need to be modified in order to implement the commuter rail station at Sullivan Square in Phase 2, and heavy rail alternative A2 in Phase 3. Figure D-15 shows part of this area.

2.2 Tail Tracks, Charlestown, Boston

Land would be needed for the LRT tail tracks near the west end of Arlington Avenue in Charlestown if the Urban Ring rail station were located underground in front of the existing Sullivan Square station. However, analysis of this alternative showed it to be considerably more expensive than the current alternatives. Moreover the tail tracks at this location would interfere with the MBTA rail bending facility. Nevertheless, land may be needed where this parcel abuts the commuter rail tracks in order to accommodate a commuter rail platform for Sullivan Square.

2.3 Existing Freight Tracks, Charlestown and Somerville

The existing freight rail right-of-way located adjacent to the Orange Line tracks at Sullivan Square and extending southwest into Somerville parallel to New Washington Street are needed to implement the LRT at-grade in Alternative B. This section of the alignment is approximately 3,800' long and 30' wide. Ownership is unclear, but it is believed that at least some portion of it is owned by Guilford Transportation, a freight railroad. Near the west end of New Washington Street the Urban Ring LRT alignment would need to obtain right-of-way needed to tunnel beneath the Lowell Commuter Rail Line. See Figure D-16.

2.4 Existing Rail Yard, Somerville

Between New Washington Street and New Lechmere the Urban Ring LRT alignment would be located in an existing rail corridor that separates the Brickbottom and Cobble Hill areas of Somerville. This area, referred to as Yard 8, would also be used as the alignment for the Green Line Extension to Medford Hillside, and as a possible relocated commuter rail corridor. It is believed that MBTA and Guilford own most of this area currently.

2.5 Cobble Hill/Boston Engine Terminal, Somerville

This segment of the LRT alignment would be 100 percent tunnel from Sullivan Square to New Lechmere. The key issue here is retaining tunnel alignment envelope through this area that is not blocked by deep pile foundation of new buildings. See Figure D-17.

2.6 Gilmore Bridge BRT Lanes, Boston and Cambridge

Two concepts are being evaluated for building BRT exclusive bus lanes connecting Rutherford Avenue with New Lechmere. The concepts require preservation of right-of-way adjacent to the existing Gilmore Bridge. The concept that works with the Rutherford Avenue Bypass Road would require some additional right-of-way at Community College and adjacent to the west side of the Gilmore Bridge. See Figures D-18 and D-19.

2.7 New Lechmere Station, Cambridge

The location and configuration of structures and their foundations in the New Lechmere development need to provide an underground easement for the Urban Ring LRT tunnel alignment. This easement needs to be beneath the planned New Lechmere Green Line Station and through portions of the proposed development. Also, the configuration of the development should allow for implementation of the BRT bus bridge connection between Charlestown and North Point referred to in Item 2.6. See Figures D-19 and D-20.

- 2.8 First Street Alignment to Kendall Square, Cambridge
The Urban Ring LRT alignment passes beneath the east end of the existing Lechmere Green Line station. Any development that occurs at this location after the Green Line station is relocated to New Lechmere must provide an underground easement for the Urban Ring tunnel. The remainder of the LRT alignment in East Cambridge is being reviewed with the City of Cambridge. Underground easements will likely be needed where the alignment curves to reach Kendall Square from First Street.
- 2.9 Main Street to the Grand Junction Railroad, Cambridge
The Urban Ring tunnel alignment turns at the southwest corner of the intersection of Main Street and the Grand Junction Railroad. An underground easement is needed to prevent structures and deep foundations from interfering with the tunnel alignment in Alternatives A1 and A2, or the surface LRT in Alternative B.
- 2.10 Union Square Urban Ring Station, Somerville
The location and general land requirements of this commuter rail and BRT station were identified in the station concept panel developed for this site early in the MIS. See Figure D-11.
- 2.11 Gilman Square Urban Ring Station, Somerville
A combined commuter rail, Green Line Extension, and Urban Ring BRT station is envisioned for this site. There is a city-owned parcel adjacent to the commuter rail tracks at Gilman Square. See Figure D-10.

Segment 3 – Cambridge, Brookline, and Boston

- 3.1 MIT/MassAvenue LRT Station, Cambridge
Land is needed at the intersection of the Urban Ring with MassAvenue for a BRT station in Phase 2 and a rail station in Phase 3. If at-grade, the station would be on the north side of MassAvenue. If the LRT station were underground there would need to be headhouses at the surface, preferably on the north and south sides of MassAvenue. See Figures D-22 and D-23. It has not yet been determined whether the BRT and underground rail alignments would be beneath the Grand Junction Railroad or Vassar Street. The at-grade rail alignment in Alternative B could only follow the Grand Junction right-of-way.
- 3.2 Grand Junction Railroad Through MIT, Cambridge
Approximately 5,300' of this corridor is needed between Main Street and Cambridgeport for the at-grade LRT alignment of Alternative B. It has not been determined how much of this alignment could be at-grade versus in tunnel. In either case, any further encroachment on the existing Grand Junction right-of-way would likely have an adverse impact on the costs and constructability of the Urban Ring in this area. See Figures D-21 through D-23.
- 3.3 Cambridgeport BRT and LRT Station, Cambridge
The location and land requirements of this station were identified in the station concept panel developed for this site and are applicable to the Phase 2 BRT as well as Phase 3 Alternative B.
- 3.4 Grand Junction Rail Bridge, Cambridge and Boston
Ongoing definition of the Phase 2 BRT alternatives include a Turnpike express bus route utilizing a modified version of this existing bridge to cross the Charles River in combination with a multi-use path and single track freight rail line. See Figures D-24 through D-26.
- 3.5 St Mary's Street Station, Brookline and Boston
The corner of St. Mary's Street and Mountfort Drive is the proposed location of a BRT and commuter rail station in Phase 2, and station headhouses to access the underground Urban Ring rail station associated with Alternative B in Phase 3. See Figure D-27.

- 3.6 Commuter Rail Platform – Framingham Line, Boston
Land adjacent to the south side of the Framingham Commuter Rail Line is needed for a commuter rail platform. For Urban Ring Alternative B the commuter rail platform would start at St. Mary's Street and extend approximately 830' east. For Urban Ring Alternatives A1 and A2, the commuter rail platform would expand the existing Yawkey Station platform from Brookline Avenue to just west of Beacon Street. These requirements would need to be accommodated by possible Turnpike Air-Rights development, Turnpike expansions or ramps, or other possible work along this segment of the commuter rail line. In Phase 2 the Urban Ring BRT would need access and a pickup/drop-off area to connect with the commuter rail station. Figure D-28 depicts the abandoned CSX rail corridor that could be used as a BRT access route to reach Yawkey station.
- 3.7 Kenmore Square/Yawkey Station, Boston
A deep underground Urban Ring rail station is proposed for Alternatives A1 (LRT) and A2 (Heavy Rail) that would cross beneath, and roughly perpendicular to, the existing Kenmore Square Green Lines, the MassPike and the Framingham Commuter Rail Line. This major Urban Ring station would link the south side of the Framingham commuter rail line with the Kenmore Square Green Line Station via an underground Urban Ring platform accessed from headhouses near Yawkey Station on the south and in Kenmore Square on the north. Development by others in this area, such as Turnpike Air Rights, needs to accommodate the underground alignment and station needs of the Urban Ring.
- 3.8 Sears Rotary, Boston
Any reconfiguration of this roadway network should provide for exclusive or priority bus treatment to provide existing and future crosstown buses in Phase 1 and BRT in Phase 2 with an efficient and dependable connection between the Longwood Medical Area and Park Drive. Additionally, the Phase 3 underground rail alignments pass through this area in tunnel. Future structures and foundations should be located so as not to interfere with an Urban Ring tunnel alignment.
- 3.9 Longwood Medical Area Station, Boston
In Phase 1 and 2 there is the need for bus and BRT surface station at the corner of Longwood Avenue and Avenue Louis Pasteur. In Phase 3 a major underground rail station is planned at the corner of Longwood Avenue and the Avenue Louis Pasteur that will require some land for headhouses. See Figure D-29.
- 3.10 Transit Easement Between Huntington Avenue and Ruggles, Boston
The existing crosstown buses and the proposed Urban Ring BRT would benefit from an exclusive or priority bus lane along Ruggles Street between Huntington Avenue and Ruggles Station. A transit easement exists along the north side of Ruggles Street between Parker Street and Tremont Street, but the proximity of new development at Northeastern University and Wentworth raises potential environmental issues that will require close coordination with those institutions. The challenge of routing the BRT between the Ruggles Street easement and the Fenway through the Huntington Avenue intersection will require additional analysis and discussion during the Phase 2 environmental process. See Figure D-31.
- 3.11 Ruggles Station, Boston
An underground transit easement for the Urban Ring was established beneath this station at the time it was built during the Southwest Corridor Project. However, while the easement beneath Ruggles is oriented toward Melnea Cass Boulevard all the Phase 3 rail alternatives would service Dudley Square. A new, more direct underground alignment between Ruggles and Dudley Square has been identified beneath Ruggles Street and Whittier Street. See Figure D-32.

Segment 4 – Dudley/Crosstown and Dorchester

4.1 Melnea Cass Boulevard Alignment, Boston

The station concept analyses provide details on the right-of-way requirements associated with at-grade and underground Urban Ring alignments along Melnea Cass Boulevard for approximately 3,200' between Tremont Street and Albany Street. Current alternatives would provide BRT service at-grade along a reconfigured Melnea Cass Boulevard. It is assumed that the existing transit easement along Melnea Cass would be utilized as part of any Urban Ring alternative along this portion of the corridor. The configuration of the BRT busway and station stops along Melnea Cass Boulevard will be determined during the Phase 2 environmental process. East of Albany Street to Massachusetts Avenue, the proposed new Crosstown Center appears to occupy the transit easement at-grade. See Figures D-34 and D-35.

4.2 Urban Ring Interface with Silver Line at Melnea Cass Boulevard, Boston

Refer to the Melnea Cass station concept analyses referred to above for information regarding the configuration of such a station.

4.3 Dudley Square Station, Boston

Phase 3 Alternatives A1, A2, and B all identify a planned underground rail station beneath Dudley Street in front of the existing Dudley Square bus terminal. An easement should be identified to enable a future Urban Ring tunnel to access Dudley Square from Ruggles and for an underground station location and headhouses at the bus terminal. Underground storage tracks will need to be located in the tunnel segment between Ruggles and Dudley Square. See Figure D-33.

4.4 Crosstown Center Station, Boston

This location is an important junction of several crosstown bus routes and proposed BRT routes. It appears that the current proposed development would occupy the BRA-owned land currently held for future transportation purposes along Melnea Cass between Albany Street and Massachusetts Avenue. Therefore, it is critical that the new development accommodate these bus and BRT routes and station at an alternative location that functions as well or better than the original route that would have used the Melnea alignment.

4.5 East Concord Street Connector to BU Medical Center, Boston

This roadway becomes essential to the routing of the Urban Ring BRT and crosstown bus routes, particularly if the BRA-owned land along Melnea Cass between Albany Street and Massachusetts Avenue is no longer available. Discussion are continuing with BRA, BTD, and others to develop an acceptable configuration and routing. Land for BRT station stops will be needed; the specific location and configuration to be determined during the Phase 2 environmental process.

4.6 Southampton Street Interface with Midlands Branch of Commuter Rail, Boston

Though not part of the current Urban Ring alternatives, land should be preserved for possible long-term future station on the Midlands Branch where it crosses Southampton Street and for access to that station from the Southampton Street level.

4.7 Mass Avenue Interface with Midlands Branch of Commuter Rail, Boston

Similar to above, this location is where the Midlands Branch of commuter rail crosses over Massachusetts Avenue. Though not part of the current Urban Ring alternatives, this location may in the long-term be needed as a station stop on the Midlands Branch.

4.8 Uphams Corner Interface with Midlands Branch of Commuter Rail, Boston

There is an existing station on commuter rail at this location. The additional right-of-way requirements would be for a BRT station stop on Dudley Street. The Urban Ring project is coordinating with the City of Boston Transit Oriented Development (TOD) study in Uphams

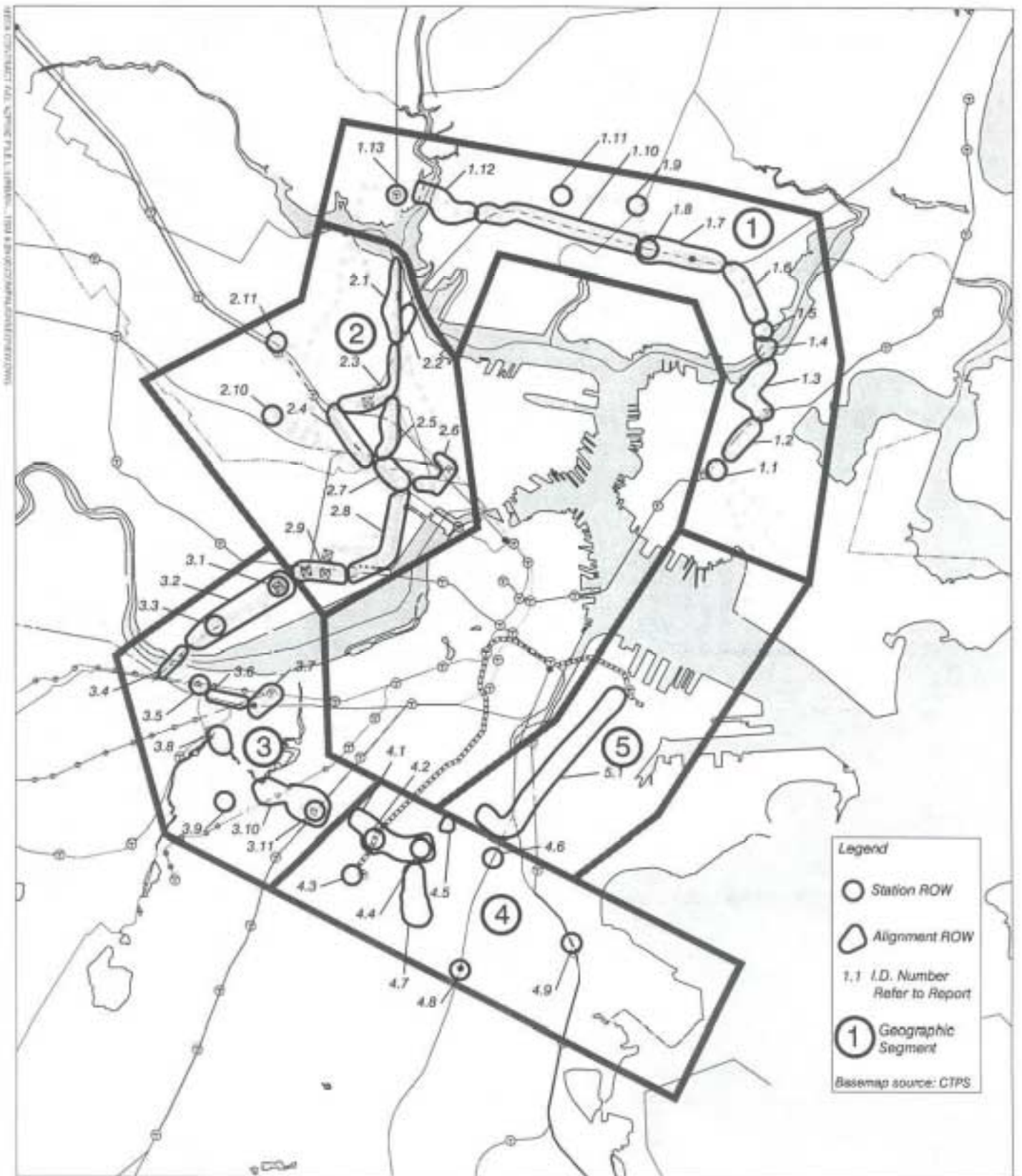
Corner on the function, location, and configuration of station at this location. See Figures D-36 and D-37.

4.9 JFK/UMass Tail Tracks, Boston

Though not part of the current Phase 3 Alternatives, an underground easement beneath the existing Red Line Station for the Urban Ring should be preserved along with a location for Urban Ring tail tracks south or east of the Red Line station should it be determined at a later date that Urban Ring rail be extended to this location.

Segment 5 – South Boston

- 5.1 Each of the Urban Ring alternatives assumes use of the existing South Boston Haul Road for future Urban Ring BRT buses. In order for the Urban Ring BRT buses to perform as expected along this corridor, they will need to be able to travel from the Mass Avenue Connector Road onto the South Boston Haul Road, make a station stop at a location yet to be determined in the South Boston Waterfront area and enter the Williams Tunnel. Though not currently part of the Phase 3 rail alternatives; this alignment should be preserved for possible long-term extension of the Urban Ring rail service to South Boston should conditions support such an extension in the future. See Figure D-38.



Urban Ring Corridor

Key Right-of-Way Issues and Requirements

EARTH  TECH

Figure D

JULY 2001



Figure D-1



East Boston view southwest at clearance beneath Rt. 1A from east to west sides.
(Phase 2 BRT Route)

Figure D-2



East Boston view south along abandoned railroad right of way adjacent to
west side of Rt. 1A. (Phase 2 BRT Route)

Figure D-3



Chelsea view north along abandoned railroad right-of-way at Belingham Street overpass.
(Phase 2 BRT Route)

Figure D-4



Chelsea view east from vicinity of Washington Avenue at vacant MBTA right-of-way
adjacent to active commuter rail tracks. Broadway overpass in distance.
(Phase 2 BRT Route)

Figure D-5



Chelsea view east from commuter rail shelter on left, Washington Avenue overpass in distance. (Phase 2 BRT Route and Station)

Figure D-6



Chelsea view west from commuter rail station. Shelter on right, Rt. 1 overpass in distance. Vacant MBTA right-of-way adjacent to left side of active commuter rail tracks. (Phase 2 BRT Route and Station)

Figure D-7



Everett view west along Revere Beach Parkway at Everett Avenue intersection.
(Phase 2 BRT Route)

Figure D-8



Everett view west at right-of-way adjacent to active MBTA commuter rail line at
Second Street. (Phase 3 BRT Route)

Figure D-9



Everett looking west from the Rt. 99 overpass showing (left to right) industrial buildings, the Guilford lead track, the MBTA two-track Neburyport-Rockport Line, high mast power poles and Rt. 16. (Phase 3 BRT Route)

Figure D-10



Somerville looking northwest at Lowell commuter rail line and location of proposed Gilman Square commuter rail and Urban Ring BRT station. (Phase 2 Station)

Figure D-11



Somerville looking southwest across Somerville Avenue at the existing City of Somerville parking at the corner of Prospect Street in Union Square. (Phase 2 BRT and Commuter Rail Station)

Figure D-12



Somerville view north at edge of Yard 21.
(Phase 3 LRT Station)

Figure D-13



Somerville view north from Mystic Avenue at (left to right) Yard 21; Orange Line inbound, outbound and test track; Haverhill commuter rail (1 track) and Newburyport/Rockport commuter rail (2 tracks) converging. (Phase 3 Heavy Rail Alternative A2)

Figure D-14



Boston view south from Broadway Street at Yard 21 lead tracks and Orange Line station. (Phase 3 LRT)

Figure D-15



Boston view north along commuter rail line at Cambridge Street overpass and Orange Line station. (Phase 2 Commuter Rail Station)

Figure D-16



Somerville view west along Wye tracks. Sweetheart Plastics on left, MBTA storage yard on right. (Phase 3 LRT Alternative B)

Figure D-17



Somerville view north at Rt. 93 Leverett/I-93 ramps and Orange Line viaduct.
(Phase 3 Heavy Rail Alternative A2)

Figure D-18



Boston view southeast at Rt. 93 viaduct and MBTA Community College station on
Orange Line. (Phase 2 BRT Route)

Figure D-19



Cambridge view southward along the west side of Gilmore Bridge at Northpoint.
(Phase 2 BRT Route)

Figure D-20



Cambridge view west at rail yard in Northpoint.
(Phase 2 BRT and Phase 3 LRT Alternative B)

Figure D-21



Cambridge view west along Grand Junction railroad right-of-way with MIT Power Plant connected by overhead structure. (Phase 2 BRT and Phase 3 LRT Route Alternative B)

Figure D-22



Cambridge view west along Grand Junction right-of-way with Mass Avenue grade crossing in foreground. (Phase 2 BRT and Phase 3 Rail Station Location)

Figure D-23



Cambridge view west along Grand Junction right-of-way MIT parking garage on left and Nabisco labs on right. (Phase 2 BRT and Phase 3 LRT Route Alternative B)

Figure D-24



Boston/Cambridge view looking northeast at Grand Junction rail bridge over the Charles River. (Phase 2 BRT Route)

Figure D-25



Boston view west across MassPike and Boston University (BU) parcel at MassPike just west of BU Bridge. (Phase 2 BRT Bus Ramps Location)

Figure D-26



Boston view west along Grand Junction rail line with MassPike viaduct and service road left side of tracks. (Phase 2 BRT Westbound Bus Ramp Location)

Figure D-27



Boston/Brookline view south along Park Drive near Mountfort Street intersection.
(Phase 2 BRT Route)

Figure D-28



Boston view east along CSX abandoned freight spur with Miner Street grade
crossing in foreground. (Phase 2 BRT Route)

Figure D-29



Boston view north toward Avenue Louis Pasteur across Oscar Tugo Circle at corner of Longwood Avenue. (Phase 2 BRT and Phase 3 Underground Rail Station)

Figure D-30



Boston view north along Louis Prang Street from vicinity of Huntington Avenue.
(Phase 2 BRT Route)

Figure D-31



Boston view north along Ruggles Street north of Parker Street intersection. Wentworth Athletic Fields on right. (Phase 2 BRT Route)

Figure D-32



Boston view south along Ruggles Street with Ruggles Station on left.
(Phase 2 BRT and Phase 3 Rail Station)

Figure D-33



Boston view northeast at Dudley Square bus station. Police station parking and Dudley Street in foreground. (Phase 3 Underground Rail Station)

Figure D-34



Boston view east along Melnea Cass Boulevard near corner of Tremont Street.
BRA-owned linear parcel on far left. (Phase 2 BRT Route)

Figure D-35



Boston view east along the north side of Melnea Cass Boulevard showing
BRA-owned linear parcel. (Phase 2 BRT Route)

Figure D-36



Boston view east along Dudley Street at Uphams Corner MBTA station on left and
commercial district beyond railroad overpass. (Phase 2 BRT Route)

Figure D-37



Boston view west along Dudley Street in Uphams Corner Commercial Center. Note on-street parking and queue in eastbound lane backed-up from intersection with Columbia Road. (Phase 2 BRT Route)

Figure D-38



Boston view northward along South Boston Haul Road. CSX rail line on right. (Phase 2 BRT Route)

Appendix E

**STATION URBAN DESIGN AND SECTION
STUDY**

1.0 Purpose

This appendix summarizes the process and findings of the station area design explorations that were undertaken by the consultant team at the potential sites for station stops along the Urban Ring. The purpose of these explorations was to inform the Urban Ring jurisdiction representatives about the feasibility of locating potential Urban Ring stations at sites along the transitway and the development opportunities and constraints associated with these concepts. In exploring these sites, the team analyzed the impact of the proposed alignments, suggested technologies, and potential Phase 2 and Phase 3 development scenarios. The team also reviewed land use and urban design plans previously articulated by the jurisdictions.

2.0 Methodology

At the beginning of the station concept exploration, the consultant team requested specific information from each jurisdiction including basemaps, current and proposed development plans, and zoning. This information was discussed with the jurisdiction representatives to determine the potential long-term development of each of the sites. Further mapping systems and information were utilized including Massachusetts Road Inventory Data. The consultant team then conducted site analysis including photographic surveys to understand the issues particular to each potential station location. Based on input received and field observations, the consultant team developed and graphically illustrated options for the sites that identify required rights-of-way for the Urban Ring alignment, possible connections to other transit modes, as well as future development potentials. The consultant team then analyzed the urban design implications of the potential development scenarios fostered by the Urban Ring.

Station design concepts were developed only for the Phase 2 and Phase 3 Urban Ring alternatives:

- Phase 2 - Bus Rapid Transit (BRT)
- Phase 3 Alternative A1 - (Kenmore) BRT and Light Rail Transit (LRT)
- Phase 3 Alternative A2 - (Kenmore) BRT and Heavy Rail Transit
- Phase 3 Alternative B - (BU/Park Drive) BRT and LRT

3.0 Urban Design Implications

Each potential development scenario of the Urban Ring stations was analyzed to understand the urban design impact of the transit investment. The conclusions drawn were based on the level of positive (or negative) effect for the urban design in that particular area, the potential for creating connections between public transit lines or creation of an intermodal transit center at a particular station, and the impact that the Urban Ring would have to foster development in a presently underutilized area.

4.0 Technical Assumptions

The consultant team has made several assumptions regarding design specifications for the transit service in order for the team to establish a consistent set of dimensions critical to the station concept studies. These assumptions are based on the standard guidelines for MBTA station and roadway design developed previously in the study. These standards are:

- Station canopy length for an articulated-bus system will be approximately 40'
- Platform length for a light-rail transit system will be 420'

- Platform length for a Commuter Rail stop will be 830'
- Side-loaded station platforms will be 12' wide
- Center-loaded station platforms will be 24' wide minimum
- Minimum curve radius for light-rail transit will be 150'
- Minimum curve radius for a Commuter Rail line will be 4,900'
- Minimum distance from the platform end to the curve tangent will be 65'
- Maximum grade for a light-rail transit system will be 5%
- Maximum grade for a Commuter Rail line will be 1.5%
- Transit reservation for an articulated-bus system will be 12' wide
- Central transit reservation for a light-rail transit system will be 30' wide
- Typical section for a light-rail at-grade station will be 24' wide
- Minimum width for a Commuter Rail corridor is 45'
- Primary headhouses will be 18' x 40'
- Secondary headhouses will be 18' x 24'
- Roadway travel lanes will be 12' wide
- On-street parking will be 8' x 20'
- Bulb-outs will be provided at major intersections and crosswalks will be 10' wide

5.0 Station Urban Design Analyses

5.1 Logan Terminals, East Boston

The Urban Ring will serve the various terminals of Logan International Airport. There will be station stops for the arrivals and departures of each terminal consistent with the redevelopment and transportation engineering improvements currently being implemented as part of the Logan Airport Modernization Program. This traffic configuration will have a two level, stacked design that will keep the arrivals and departures traffic separate.

The Urban Ring technology will be a BRT system that will navigate the redesigned Logan traffic one-way circulation roadway. A width of 36' will be needed for the Urban Ring; this will be comprised of a 12' drop-off lane, a 12' passenger station and canopy, and a 12' passing lane. A station at these stops will serve the vast number of passengers to the airport and will help to relieve the burden of the MBTA Blue Line. Given the unique nature of an airport development, the Urban Ring at this location will not have any potential urban design implications. Figure 1 shows the Logan Terminals BRT Station.

5.2 Airport Blue Line Station, East Boston

The Urban Ring's Airport Blue Line station stop will be part of the redesign of the present MBTA Blue Line station. This station is an important site at the edge of the East Boston residential neighborhood and Logan International Airport, on the fault line of Route 1A. The Urban Ring stop would be a one-way curb area serving both directions at-grade adjacent to the Blue Line station structure. Both north bound and south bound Urban Ring vehicles would use the same station platform. A design of this nature would require a 36' right-of-way for the station canopy shelter, bus loading zone, and a bypass lane.

The Urban Ring at this location is envisioned as BRT for the immediate and final development scenarios. In the present redesign by the MBTA, provisions have been made to accommodate a bus lane at this site. An Urban Ring station at this site would provide service to local East Boston residents, passengers arriving or departing the airport, passengers of the Blue Line, as well as provide access to Memorial Park and Bremen Street Park. The Urban Ring at this site would provide connections with the MBTA Blue Line as well as the airport terminals bus loops. Given the station's relative location as part of Logan Airport, there would not be any appreciable urban design implications for the area. Figure 2 shows the Airport Blue Line BRT Station.

5.3 Chelsea Commuter Rail Station, Chelsea

The potential Urban Ring station site is parallel to and adjacent to the existing Commuter Rail line between Washington Avenue and Route 1. This site is primarily characterized by the Chelsea residential neighborhoods. The potential Urban Ring station would be at-grade, directly adjacent to the present Commuter Rail station platforms. A station aggregation of this type would require a right-of way of 125' and would require the construction of an overhead circulation system that would permit pedestrians to safely cross over the rail tracks when changing modes of transport. The Urban Ring allotment of this 125' would be 68' including transit lanes, station platforms and station headhouses. The Urban Ring station would need to be within the approximately 600' between the Washington Avenue overpass and the Route 1 overpass. Site constraints include the width beneath the Route 1 overpass, which is approximately 82' between columns, steep grades on the south side, and existing utilities. This station would serve local residents of Chelsea as well as transfers from the Newburyport / Rockport Commuter Rail line. In both the Phase 2 and long-term development scenarios, the technology considered at this segment of the Urban Ring would be a BRT system. Figure 3 shows the Chelsea Commuter Rail BRT Station.

5.4 Everett Avenue / Mystic Mall, Chelsea

The proposed Urban Ring alignment at this site would be in a dedicated BRT busway along the Commuter Rail right-of-way between Everett Avenue and Spruce Street. The site is presently occupied by the Ipswich / Rockport Commuter Rail Line and is surrounded by underdeveloped parcels. The potential station site lies along the rail track in the approximately 600' between the two crossing streets. The Urban Ring station would be at-grade with side platforms, but there would not be an interface with the Commuter Rail at this location. The Urban Ring at this location is envisioned as BRT, and would require a right-of-way of 48' parallel to the 31' of the Commuter Rail. The existing corridor width at this location is 80'. This location provides access to the commercial zone along Everett Avenue and to the Mystic Mall. The investment of public transit at this location would foster the development of many of the vacant parcels in the vicinity. The redevelopment of these sites and the combination with the other commercial resources of the area would make this an emerging district. Figure 4 shows the Everett Avenue BRT Station.

5.5 Revere Beach Parkway, Everett

This Everett station site would be curbside on Revere Beach Parkway, to the west of the Everett Avenue intersection. Revere Beach Parkway is a major vehicular boulevard that borders the residential fabric of Everett to the north and the low-density commercial structures to the south. The Urban Ring would be BRT at-grade in mixed traffic on Revere Beach Parkway. A 99' right-of way would provide 3 west bound and 3 east bound lanes of traffic as well as 12' public sidewalks that could accommodate an Urban Ring station canopy. Presently configured, Revere Beach Parkway is 99' in width. A station at this site would serve Everett and Chelsea residents and provide access to Memorial Stadium, as well as connect to MBTA Bus route #122. The investment of a strong public transit system in this area could help spur development and create a stronger edge along the south side of the parkway, although this boulevard will continue to be of an automobile oriented nature. Figure 5 shows the Revere Beach Parkway BRT Station.

5.6 Second Street, Everett

The Second Street Everett station would be along the Commuter Rail right-of-way, at the intersection with Second Street. This area is characterized by large-scale, low-density,

independent commercial and institutional structures. The Urban Ring investment in this area in Phase 3 will be at-grade BRT service. An Urban Ring station at this location would serve the commercial interests and potential future development. An 82' right-of-way would be needed for the dedicated busway, station platforms, and the Commuter Rail tracks. An Urban Ring station at this site would be a 12' wide platform with a freestanding canopy on the side of the busway, and there would be no connections to other transit lines. This area has several developable parcels that would become more desirable with the investment of the public transit system of the Urban Ring. Given the relative low-density of development, here is a great potential for a re-planning of this area. Figure 6 shows the Second Street BRT Station.

5.7 Broadway, Everett

The station would be located on the north side of the Route 99 / Revere Beach Parkway rotary. This location is a major vehicular transportation hub including MBTA bus transit. The Urban Ring BRT service would provide connections to MBTA bus routes #97, #99, #106, #110, #112. A station at this location would serve commercial areas of Everett center as well as provide a number of links to the other bus routes.

An Urban Ring station located at this site should be distinct from the rotary traffic; a bus drop-off zone and station canopy should be separated by a small median. A configuration of this type would require a 78' width on this segment of the rotary. The present configuration of the rotary is 90' in width, however further studies by traffic engineers should be undertaken to study the traffic patterns at this center. Figure 7 shows the Broadway BRT Station.

5.8 Wellington, Medford

The Urban Ring station site would be adjacent to the existing MBTA Wellington station at the confluence of the Mystic and Malden Rivers. This area is dominated by the station, large, open parking facilities, and neighboring rail yards. A station at this site would be part of a major intermodal center with the Urban Ring transit line, the Orange Line, as well as connections to MBTA bus routes #90, #97, #99, #100, #105, #108, #110, #112 and #134. At this location, the Urban Ring would primarily serve passengers making connections to and from other modes of public transport, as well as the Mystic River Park and a small residential area of Medford along Middlesex Avenue. In the Phase 2, the Urban Ring would be BRT service and would necessitate a 36' width adjoining the existing Wellington bus drop-off areas (see Figure 8). In the long-term, Alternative A2 heavy rail would utilize the existing Orange Line tracks (see Figure 9).

5.9 Assembly Square, Somerville

The Urban Ring LRT station at this site would be adjacent to and parallel to the Commuter Rail and Orange Line tracks, north of the Mystic Avenue / I-93 overpass. The area is at the back of several small uncoordinated structures, just to the south of the mall site. This location is presently underdeveloped, however, plans for the redevelopment of the Assembly Square Mall are presently being explored. In the Phase 2, the Urban Ring would be an at-grade BRT system. In addition to the width of the existing Commuter Rail and Orange Line tracks, the Urban Ring will need an allotment of 52' to accommodate the station platforms and BRT reservation. There would not be an Orange Line interface at this location in Phase 2 (see Figure 10). In the long-term development of Phase 3- Alternatives A1 and B, this would be augmented by a light-rail system (See Figure 11). Given the redevelopment plans of this area presently underway, there will be a large opportunity for the Urban Ring to foster and to shape the development of the area.

5.10 Gilman Square, Somerville

The station at this location would be in a city-owned parcel at the southeast corner of Pearl Street and Medford Street. This is a dense, residential community and local commercial center of Somerville. Transit service in this area would serve the center of Somerville, with access to City Hall, the Public Library, Somerville High School, and Central Hill Park. This segment of the Urban Ring will be BRT service in mixed traffic. This is seen as the long-term investment as part of the Phase 3- Alternative A. At this location, the Urban Ring would connect with a proposed new Commuter Rail stop, the Green Line Extension contained in the Regional Transportation Plan, and existing MBTA bus routes #88 and #90. There is a large amount of potential extension and urban design development at this location including redevelopment of the school buildings. Given the large investment in public transit, this area could become a reinvigorated focal point of the surrounding community. Figure 12 shows the Gilman Square BRT Station.

5.11 Union Square, Somerville

The most-likely potential station site at this location would be at Prospect Street where it crosses the Commuter Rail tracks. Union Square is a vibrant commercial center encircled by dense residential development. This area is Somerville's oldest industrial district and is presently undergoing revitalization. A station at this location would serve the heart of Somerville, the commercial interests of a revitalized Union Square, as well as provide connections to the Commuter Rail.

A transit station at this location would become a major intermodal center in the public transit network of the north of Boston. BRT service as part of the Urban Ring is envisioned in both the short- and long-term development scenarios. This bus would operate in a dedicated transit corridor adjacent to the existing Commuter Rail tracks through Somerville. The long-term development vision includes a new stop for the Lowell branch of the Commuter Rail. The combination of these transit modes with the existing service of MBTA bus routes #85, #86, #87, and #90 would make Union Square a key node in the city's transit infrastructure. The public transit initiative of the Urban Ring would foster the continuing revitalization of this area and provide an ideal location for stronger urban design. Figure 13 shows the Union Square BRT Station.

5.12 Sullivan Square, Charlestown

The Urban Ring at Sullivan Square would provide BRT service in Phase 2 and in the long-term a rail alternative. The Urban Ring would create connections with the existing MBTA station and would serve as a catalyst for new development on potential sites that are presently underutilized. This area is at the edge of the residential East Somerville neighborhood and former commercial uses of Charlestown that is bisected by the overpass of Route 93. This site is constrained from an engineering point-of-view by the many columns that support the elevated Interstate-93 highway above the site. These will necessitate further study of the layout of any rail alignment that would connect to the present MBTA station. The Urban Ring in this area would provide a safe pedestrian connection with the new development, landscaped boulevards, and public amenities associated with the recently completed Rutherford Avenue Corridor Transportation Study. This location would become a major connection point for various modes of public transit. The Urban Ring would connect to the existing Orange Line, MBTA bus routes #86, #89, #90, #91, #92, #93, #95, #101, #104, #105 and #109, as well as a potential connection in the future to the Haverhill and Newburyport / Rockport Lines of the Commuter Rail system. The Urban Ring Sullivan Square station would serve East Somerville as well as potential new development conceived for this area. The Urban Ring has a major opportunity to be a part of, and to encourage the development of this district. Figure 14 shows

the Sullivan Square BRT Station concept. Figure 15 shows the LRT station concepts for Alternatives A1 and B, and Figure 16 shows the Alternative A2 heavy rail station concept.

5.13 New Washington Street, Somerville

The New Washington Street Urban Ring station will be located adjacent to Washington Street on its south side. This is a largely industrial area in East Somerville bordered by the heavy rail and manufacturing yards. The New Washington Street station would be part of a long-term investment strategy as part of the Urban Ring's Phase 3- Alternative B that would create an at-grade rail corridor in this area. This built out option would also necessitate an 88' corridor width. This station stop would serve the residential East Somerville neighborhood to the north, and potential future development of the industrial yards to the south. Interface with other modes of public transit at this location are not planned at this time other than possible bus connections. Given the largely underdeveloped nature of the industrial district to the south, the Urban Ring infrastructure and its ability to bridge public transit service between the Orange Line to the north and the Green Line to the south would serve as a major catalyst for the urbanization and redesign of this area. Figure 17 shows the Alternative B New Washington LRT Station.

5.14 Community College, Charlestown

The Community College site is at the division of Somerville and Cambridge created by the elevated Interstate 93. This site is dominated by industrial, underdeveloped areas to the west and by the Bunker Hill Community College to the east. This Urban Ring station stop for BRT service would be implemented during Phase 2 and would remain in place in all alternatives of Phase 3. The Urban Ring BRT is envisioned to use a separate dedicated busway bridge connected to a possible relocated Rutherford Avenue Bypass Road by others. A station stop at this location would serve the students and faculty of the community college as well as the Charlestown residents from the Bunker Hill neighborhoods beyond. An Urban Ring station at this site would provide the opportunity to connect to the Orange Line. Figure 18 shows the Community College BRT Station.

5.15 Fitchburg Street, Somerville

The Fitchburg Street station would be parallel to the existing rail tracks, north of Msgr. O'Brien Highway at the intersection with Fitchburg Street. This area is relatively isolated and borders the industrial rail yards to the north and the back of the East Cambridge residential neighborhoods to the south. This station would be an at-grade rail line as part of the Urban Ring Phase 3- Alternative B. An alignment of this type would require a width of 48' in addition to the width needed for the tracks of the Green Line extension. An Urban Ring station in this location would serve the commercial and residential interests of the north section of East Cambridge and the Twin City Mall. Figure 19 shows the Fitchburg Street LRT Station.

5.16 New Lechmere Station, Cambridge

The Urban Ring at this location would be part of the redevelopment of the New Lechmere Green Line station. This area is on the edge of the MBTA rail yards to the north and east, and the East Cambridge commercial and residential neighborhoods to the south and west. The Urban Ring technology for this segment would be an at-grade bus rapid transit vehicle in mixed traffic for Phase 2 that would be augmented by a below-grade rail service in all long-term investment alternatives. The public transit investment at this location would serve East Cambridge, the Cambridge Galleria, and the passengers connecting to the green Line. This would allow the Urban Ring to connect to the Green Line and MBTA bus routes #69, #80, #87, and #88. The Urban Ring investment would continue the revitalization of this area and increase the desirability for future development in the area. Figure 20 shows the New Lechmere BRT

Station concept. Figure 21 shows the station concept for Alternative B (LRT), and Figure 22 shows the rail station concept for Alternatives A1 and A2.

5.17 First Street / Binney Street, Cambridge

The First Street site is located between the residential and commercial blocks of East Cambridge and the Cambridgeside Galleria shopping mall. The primary site issue is the constrained existing street width which is 47' from building edge to building edge. An Urban Ring station at this site would serve the ethnic neighborhoods of East Cambridge and provide access to the commercial interests including the shopping mall. The Urban Ring investment at this location would be an at-grade bus rapid transit vehicle in mixed traffic for Phase 2 (see Figure 23). In the long-term development scenario of Phase 3, a below-grade rail tunnel would be constructed at Binney Street (see Figure 24 showing Alternative B LRT).

5.18 Kendall / MIT, Cambridge

The Kendall / MIT area is presently dominated by the high-tech sector clustered at the intersection of Main Street and Broadway in Cambridge. Also in the vicinity is the large institutional presence of the Massachusetts Institute of Technology including the List Center for the Visual Arts. Phase 2 of the Urban Ring implementation would provide an at-grade BRT system (see Figure 25). This service would be augmented by a below-grade rail alignment in both Alternatives A1 and A2 of Phase 3 (see Figure 26). The Kendall / MIT Urban Ring station will interface with the Red Line and the MBTA bus routes CT2, #64, #68, and #85. A station stop at this location would serve the technology business clusters, the students and faculty of MIT as well as transfers from the Red Line and MBTA bus routes. The potential transit interfaces at this location will make this an important station location and will help continue the urban redesign of this area.

5.19 MIT / Mass Avenue, Cambridge

The MIT / Mass Ave station site would be within the existing Grand Junction right-of-way, parallel to Vassar and Albany Streets in Cambridge. This area is the edge between the large scale commercial and industrial sectors of Cambridgeport along Mass. Ave., and the large institutional campus of the Massachusetts Institute of Technology. In the Phase 2 development scenario of Phase 2, a BRT system would run at-grade in a reserved busway along the Grand Junction right-of-way. A configuration of this type would require a 36' width for the Urban Ring, and would maintain a 17' right-of-way for the railroad tracks as well as provide an access road (see Figure 27). Phase 3- Alternative B would also use at at-grade alignment for LRT, however this would be an at-grade alignment using part of the Grand Junction right-of-way (see Figure 28). In Phase 3- Alternative A, a below-grade Urban Ring rail line would be added to this service (see Figure 29). The primary site constraint involves Phase 2 and Phase 3- Alternative B, which would involve an at-grade rail crossing of Massachusetts Avenue. There would be the potential to connect with the MBTA bus routes CT1 and #1 at this location. An Urban Ring station at this location would serve the students and faculty of MIT as well as provide access to some of the institutional interests concentrated on Albany Street. This area is presently being built-out to its potential, and the Urban Ring infrastructure at this site would provide an excellent opportunity for an urbanization and further redevelopment of this area.

5.20 Cambridgeport, Cambridge

The Urban Ring Cambridgeport station location is at the edge of the residential Cambridge district within the Grand Junction right-of-way, near Putnam Avenue and Waverly Street. This area is at the edge of several competing forces, most significantly the industrial and commercial interests along Waverly Street and Vassar Street, Fort Washington Research Center, the low-

scale Cambridgeport residences, the high level of development fronting Memorial Drive, and the large presence of the Massachusetts Institute of Technology. In Phase 2, the surface of the rail corridor would be redeveloped with an at-grade busway for BRT (see Figure 30). In Phase 3- Alternative B, a surface LRT rail alignment would be added to this service (see Figure 31). The rights-of-way at this location would be similar as the MIT / Mass. Ave location. station site. The station would not have any transit interface potential, but would serve the Cambridge and Tech Park employees, residents and MIT students, and would provide access to the Fort Washington Park and to Memorial Drive and the Charles River. The most challenging constraint of the site would be the engineering of the tunnel for Phase 3- Alternative B, and the safety of an at-grade rail line and portal for the tunnel. The Urban Ring at this site would provide excellent urban design opportunities including redeveloping underutilized parcels, strengthening the neighborhood fabric, re-linking the residential neighborhoods to the river, and providing improved community access.

5.21 BU / St. Mary's, Brookline

This area is bounded by the residential neighborhoods of Brookline to the south and by the Boston University campus to the north. At the BU Bridge, the continuity of the campus is interrupted by the crossing of the Massachusetts Turnpike. The Mountfort Street site could address this condition by incorporating potential air-rights development above the turnpike that the MTA has already envisioned for this area. This site was selected to study the possibilities of an Urban Ring station in the proximity of Boston University, and the feasibility of interfacing this transit service with both the Framingham / Worcester Commuter Rail line and the Green Line "B" branch. It would be unlikely that a direct connection could be made with the Green Line given the relative distance from the Mountfort Street site. In Phase 2 development scenario, the BU / ST. Mary's stop would be part of the at-grade BRT alignment (see Figure 32). In the long-term development of Phase 3- Alternative B, this would be replaced by a below-grade investment of an Urban Ring rail system (see Figure 33).

The primary constraint of the site is creating a smooth passenger transition to the depth needed for the Urban Ring tunnels. Another site issue includes balancing the level of development between the low-scale detached residential structures of Brookline with the development of the university presence and the commercial interests of Commonwealth Avenue. This station would serve Boston University, transit riders who may then switch to the other public transit modes, and the Brookline residential neighborhood of Cottage Farm. The Urban Ring investment, combined with potential air-rights development presents a major opportunity to enhance the urban design of this area.

5.22 Kenmore / Yawkey, Boston

The Kenmore / Yawkey site has been investigated to expand the MBTA service to Fenway Park and the Kenmore Square area. Kenmore Square is a major urban node that serves as a hub for both vehicular and public transit. This area is presently dominated by the baseball stadium, the commercial interests of Brookline Avenue, Landsdowne Street, and Kenmore Square. The area is also bisected by the Massachusetts Turnpike and has several vacant parcels that could be part of a larger investment in the area. An Urban Ring rail station at the site would create a transit interface with the Framingham / Worcester branch of the Commuter Rail as well as the Green Line at Kenmore station.

In Phase 2, an Urban Ring BRT station would be located along the Commuter Rail tracks at the existing Commuter Rail Yawkey station stop (see Figure 34). This site would be part of the long-term investment of the Urban Ring Phase 3- Alternatives A1 and A2. This major investment would be located below-grade with station headhouses at Brookline Avenue and an underground pedestrian connection to the Green Line (see Figure 35). A station at this location would serve the dense urban center of Kenmore as well as provide increased access to

Fenway Park which would help relieve the overburdened Green Line. This would call for a below-grade rail alignment connecting the Longwood Medical area with Cambridgeport. Given the important nature of Kenmore Square in the urban geography of Boston, and the plans for the redevelopment of this area, the Urban Ring could focus more potential for development at this location. However, given the changing climate of redevelopment plans for the area and the potential relocation of Fenway Park, further studies will need to be completed to be coordinated with the future of the area. In Alternative B (not shown), the section would be similar and would be located beneath Park Drive between the Green Line C and D Branches.

5.23 Brookline Avenue/ Fenway, Boston

The station stop of Fenway is located in a dynamic area that engages a series of major forces. In this location the open space of the Riverway and Fenway join together, and major vehicular boulevards of the Fenway, Park Drive, and Brookline Avenue converge. This area has a series of large institutional presences, commercial development, and neighboring residential sectors. In Phase 2 development, this segment of the Urban Ring would be an at-grade BRT alignment with a station stop at Brookline Avenue at the beginning of the Riverway (see Figure 36), or alternatively on Park Drive. In the long-term development of Phase 3, the station would be below-grade in the same location, as part of an underground rail alignment for Alternatives A1 and A2 (see Figure 37). This Urban Ring station would serve Fenway Park, the Fenway residential community, and the retail clients of the newly redeveloped Landmark Center. The Urban Ring infrastructure investment would be a catalyst for the further densification and urbanization of this area.

5.24 Longwood Avenue / Avenue Louis Pasteur, Boston

The Urban Ring will have a station at the Longwood Medical Campus on Avenue Louis Pasteur at its intersection with Longwood Avenue. This site is dominated by the large institutional development of the Brigham and Women's Hospital, the Beth Israel Deaconess Hospital, the Dana Farber Cancer Institute, and the Harvard Medical School and Boston Latin School. This station will provide connections to the MBTA bus route CT2.

Phase 2 of the Urban Ring would provide a BRT system for this site (see Figure 38); in the long-term development of Phase 3, this service would be supported by a below-grade rail transit structure (Figure 39 shows the Alternative A1 and A2 Station). The primary site constraint of this site would be the narrow width of the street at 59'. For the at-grade alignment, the Urban Ring station stops would have to be offset to accommodate the additional width of the station platforms. This area is almost fully developed and would not contain urban design potential, but it remains an important nucleus for the Urban Ring to connect with.

An additional at-grade BRT station on Avenue Louis Pasteur east of Fenway is being considered. This station would provide additional access to the LMA as well as to Simmons College and Emanuel College. This station is shown graphically in Figure 40.

5.25 Ruggles Street / Green Line E, Boston

Huntington Avenue is a dense mixed-use corridor with a series of major institutional centers. The Urban Ring station at this location will be an at-grade bus rapid transit system with the station on Ruggles Street south of Huntington Avenue. This segment of the BRT route will be implemented during Phase 2 and continue as a long-term investment. Given the constraints of the street width, the station platforms may have to be staggered. An Urban Ring station at this location may provide an interface with the Green Line E branch and MBTA bus routes CT2, #8, #39, and #47.

A station at this location would serve the Fenway residential area and provide access to the adjacent major institutions of the Museum of Fine Arts, Wentworth Institute of Technology, and Northeastern University, and the Greek Orthodox Cathedral. This area is being built-out and would not provide urban redesign potential, however the number of cultural and institutional focal nodes in the area would make this an important link of the Urban Ring. Figure 41 shows the Ruggles Street BRT Station.

5.26 Ruggles / Whittier Street, Boston

At the western edge of Melnea Cass Boulevard is the existing Ruggles Station where an underground easement was established as part of the original design to provide for a connection to a future Urban Ring transit line. This area is being developed as a major urban node and is surrounded by Northeastern University, commercial development, the Boston Police Department headquarters, Wentworth Institute of Technology, and public housing projects. An Urban Ring station at this location would provide a potential transit interface with the Orange Line, the Needham branch and Attleboro branch of the Commuter Rail, and MBTA bus routes CT2, CT3, #8, #15, #19, #22, #23, #28, #29, #42, #43, #44, #45, and #47. This Urban Ring station will provide access to major institutions such as the universities, or the Boston Police Department headquarters. In the Phase 2 development scenario, the Urban Ring at the Ruggles Station will be BRT service in a dedicated busway (see Figure 42). In the long-term development, all three alternatives call for implementation of a below-grade rail tunnel (see Figure 43). This section of the city has been recently redeveloped with the creation of a major transportation node. This area will continue to undergo extensive urban evolution, and the Urban Ring infrastructure would serve as a catalyst for development.

5.27 Dudley Square, Roxbury

The Urban Ring station at this site will be at the heart of Roxbury in Dudley Square, an area that is one of the primary focal points in the districts to the south of Boston. Dudley Square has a mix of residential and commercial buildings that combine to generate a distinct sense of a neighborhood community. It is a prime area for the refurbishment of historic structures and the development of vacant parcels towards its periphery. The MHD and MBTA are presently upgrading the street design and public realm with the implementation of the Washington Street Reconstruction project and the new Silver Line. The primary site constraint for Phase 2 BRT will be the severely congested traffic flow around Dudley Street.

This is presently the major hub of transportation for the southern parts of Boston. The investment of the Urban Ring would provide a transit interface with the planned MBTA Silver Line as well as connections to bus routes #1, #8, #14, #15, #19, #23, #28, #41, #42, #44, #45, #47, and #66. This station would serve the concentration of local commercial interests of Dudley Square as well as the large residential population of Roxbury including the Orchard Gardens Housing complex. It would also provide access to the number of Roxbury community buildings in the area including the Roxbury District Court, the Dudley Branch Library, the Roxbury Post Office, the District B-2 Police Station and Madison Park High School. In Phase 2, BRT service would be provided to this station (see Figure 44). In the long-term, this station would serve as the terminus of a below-grade rail system in both Alignments A and B of Phase 3 of the Urban Ring (see Figure 45). This is one of the most important areas of urban design that would be fostered by the investment of the Urban Ring.

5.28 Melnea Cass Boulevard / Silver Line, Boston

A station at the intersection of Washington Street and Melnea Cass Boulevard will provide the Urban Ring with the opportunity to connect with the proposed MBTA Silver Line. This area is presently underdeveloped, with a number of development parcels and the potential future

development of the boulevard of Melnea Cass. This segment of the Urban Ring would provide access to Ramsey Park and Jim Rice Field, and to industrial sites in the vicinity. The BRA owns a 40-foot linear parcel along the north side of Melnea Cass Boulevard.

The Urban Ring investment in this area in both Phase 2 and long-term will be an at-grade BRT system that will have a dedicated busway (see Figures 46, 47, and 48). Various configurations of the surface are being investigated including a central busway reservation (Option A), a side busway reservation (Option B), or dedicated lanes for the Urban Ring buses on the north side (Option C). Each streetscape configuration would provide for a wide landscaped swath and multi-use path along the redeveloped boulevard. This Urban Ring station will have a potential transit interface with the Silver Line, and MBTA bus routes CT3, #1, #8, and #49. This area has major development potential that would be spurred by the public transit investment of the Silver Line and the Urban Ring.

An additional station location is being considered for the South Boston Medical Center Area. The feasibility and location alternatives for an additional station have not been identified at this time.

5.30 Blue Hill Avenue, Roxbury

The site for the Urban Ring station stop will be at the intersection of Blue Hill Avenue and Dudley Street. This area is predominantly residential with two newly landscaped community plazas and the church of St. Patrick's as the focal building. There is the potential for a large investment in some of the underdeveloped parcels at the periphery of the site. The primary site constraint will be the narrow width of the street and the resulting traffic congestion. This segment of the Urban Ring would be an at-grade bus rapid transit vehicle in mixed traffic. Dudley Street is 65' wide, which would provide 2 lanes of traffic in each direction and 10' sidewalks that would contain the station shelters and platforms. The Urban Ring would supply public transit for the residential neighborhoods surrounding Blue Hill Avenue and would provide connections to MBTA bus routes #15 and #45. Figure 49 shows the Blue Hill Avenue BRT Station.

5.31 Uphams Corner

This urban node is characterized by the local commercial centers, community buildings, residential fabric, the Strand Theater, and the verdant open space of the North Dorchester Cemetery. A station at this site would provide connections with the Franklin branch of the Commuter Rail and MBTA bus route #15. Similar to the previous section, the width of Dudley Street would be reconfigured to provide 2 lanes of traffic in each direction and 10' sidewalks that would contain the station shelters and platforms. This segment of the Urban Ring would be a bus rapid transit in mixed traffic that would connect to Roxbury to the north and to JFK / UMass to the east. The Urban Ring in this location would serve the residential area surrounding Uphams Corner. The BRT station would be coordinated as a key component of the Transit-Oriented Development project currently being planned for Uphams Corner. This area would be significantly enhanced with the infrastructure investment of the Urban Ring, which would in turn foster important urban redevelopment. Figure 50 shows the Uphams Corner BRT Station.

5.32 Edward Everett Square, Dorchester

The Urban Ring station at this location would be adjacent and parallel to Columbia Road. This area is the confluence of vehicular boulevards rather than an urban node. It has a small amount of commercial activity and some residential character on its periphery, but is predominantly surrounded by underutilized parcels. The Urban Ring would serve to connect this area with Uphams Corner to the west and JFK / UMass to the east. The Urban Ring would be an at-grade bus rapid transit vehicle in mixed traffic. This system would be implemented in Phase 2

and maintained in the long-term scenario of Phase 3. This station would provide a potential transit connection to MBTA bus routes #8, #16, and #17. There is a tremendous amount of potential development at this location, however it would require a shift away from automobile oriented development. Figure 51 shows the Edward Everett Square BRT Station.

5.33 JFK / UMASS, Columbia Point

The Urban Ring would connect with the Red Line at the existing JFK / UMASS station stop. This site at Kosciuszko Circle is a difficult edge condition with many diverse influences acting within it. The present station straddles the Southeast Expressway, is separated from the Dorchester residential district to the west of the highway, is open to the landscaped spaces of the southern edge of Columbus Park, and is backed by the large-scale isolated commercial centers along Morrissey Boulevard such as Star Market, the Channel 56 station, the Boston Globe headquarters, Bank Boston offices, and the Bayside Expo Center.

This segment would be the at-grade bus rapid transit system that is implemented in Phase 2 and continued through Phase 3. The Urban Ring would have a bus drop-off loop adjacent to the existing Red Line station. A configuration of this type would require a 40' width to provide for a 12' bus zone, a 12' passing lane, and a 12' station platform and stair access to a pedestrian bridge. Figure 52 shows the JFK/UMASS BRT Station.

5.34 UMASS Campus, South Boston

The UMass campus sits on the peninsula of Columbia Point overlooking Dorchester Bay. The location for the Urban Ring station stop would be at the existing bus loop in front of the primary entrance to the university. This segment of the Urban Ring includes a bus rapid transit vehicle that would require a 36' width comprised of a 12' station platform, a 12' bus loading zone, and a 12' lane for vehicles to bypass the bus. This infrastructure is part of the development of Phase 2 and would continue as part of Phase 3. An Urban Ring station at this site would serve the UMASS Boston faculty and students. The Urban Ring in conjunction with the university has the potential to spur development. Figure 53 shows the UMASS Campus BRT Station.

5.35 Crosstown / Albany Street, Boston

The Crosstown Center site lies at the eastern edge of the Melnea Cass Corridor, at its intersection with Albany Street near Hampden Avenue. This is an emerging focal point in the city with major employment areas: the Crosstown Center and Boston Medical Center land Biosquare located nearby. The area to the south west are currently underutilized and have great potential for development.

This location would have an at-grade BRT station on Albany Street for both Phases 2 and 3. The BRT would travel in mixed traffic along Albany Street. The northbound and southbound station stops may need to be staggered due to the width of the roadway that is constrained by on-street parking. Bus pull-outs may eliminate some on-street parking spaces. The BRT station in this location would create connections between the Urban Ring and the MBTA bus routes #8, #10, and #47. A station stop at this location would provide access to the major institution of the medical complex and the emerging commercial district. Figure 54 shows the Crosstown/Albany Street BRT Station.

5.36 Biosquare, Boston

The Biosquare area station lies at the eastern edge of the Melnea Cass Corridor, at its intersection with Massachusetts Avenue and the Mass Ave Connector. This is an emerging focal point in the city with major employment areas: the Boston Medical Center, New Market

area, and the future development of 700,000 square feet within the Biosphere Planned Development Area. The area is dominated by the major institutional presence of the Boston Medical Center between Harrison Street and Albany Street, but also has a residential segment to the northwest between Harrison Street and Washington Street. The area to the southeast, at the confluence of Massachusetts Avenue, Melnea Cass Boulevard and Southampton Street is largely derelict, typified by low-density and unrelated structures with vacant or underutilized parcels.

The growth scenario for this site calls for an at-grade bus rapid transit system in both the Phase 2 and Phase 3 stages of development. The BRT station would be located near East Concord Street which would connect to the Massachusetts Avenue Connector that accesses Interstate-93. The station would be at-grade on a new roadway off East Concord Street. A station in this location would create connections between the Urban Ring and the MBTA bus routes CT1, CT3, #8, and #10. A station stop at this location would provide access to the major institution of the medical complex and the emerging commercial district. Figure 55 shows the Biosquare BRT Station.

5.37 Boston Convention Center / Court House, South Boston

The Urban Ring will serve the proposed Boston Convention Center and Moakley Federal Courthouse in South Boston by providing a new station. The station would be located at the Convention Center site bounded by Northern Avenue, New Northern Avenue, Sleeper Street and Pittsburg Street. Because the final design concepts of the Convention Center have not been completed, the exact station location for the Urban Ring is not identified at this time. The new station will be served by BRT for Phase 2 and long-term phases, and is envisioned to be at-grade.

There are two proposed alternative BRT routes for accessing the Boston Convention. For Option A, the BRT would use the MassPort South Boston Haul Road between the Mass Ave Connector and the Ted Williams Tunnel. Traffic on the Haul Road will continue to be limited to transit, commercial traffic, and taxis in the future. For Option B, the BRT would travel in mixed-traffic on the I-93 Frontage Road and in the new MassPike Fort Point Channel Tunnel.

The station is located in the emerging Seaport area of South Boston consisting of the new Court House, the proposed Boston Convention Center, the World Trade Center, and Seaport Hotel. The Urban Ring will provide access to the Boston Harbor and contribute to the continuing development of this dynamic area. Figure 56 shows the Convention Center BRT Station.

6.0 Station Concept Graphics

The consultant team has produced the following graphics to illustrate a diagram of the potential transit stations of the Urban Ring. Multiple visions for a particular station stop are illustrated when there is a Phase 3 alternative that differs from the Phase 2 investment. Please note that the following graphics are conceptual only. The actual station locations and configurations will be determined in subsequent environmental and design phases.

Fig. 1	Logan Terminals, East Boston	BRT
Fig. 2	Airport Blue Line Station, East Boston	BRT
Fig. 3	Chelsea Commuter Rail Station, Chelsea	BRT
Fig. 4	Everett Avenue / Mystic Mall, Chelsea	BRT
Fig. 5	Revere Beach Parkway, Everett	BRT
Fig. 6	Second Street, Everett	BRT
Fig. 7	Broadway, Everett	BRT

Fig. 8	Wellington, Medford	Phase 2, BRT
Fig. 9	Wellington, Medford	Phase 3, A2
Fig. 10	Assembly Square, Somerville	Phase 3, A2
Fig. 11	Assembly Square, Somerville	Phase 3, A1 & B
Fig. 12	Gilman Square, Somerville	BRT
Fig. 13	Union Square, Somerville	BRT
Fig. 14	Sullivan Square, Charlestown	Phase 2, BRT
Fig. 15	Sullivan Square, Charlestown	Phase 3, A1 & B
Fig. 16	Sullivan Square, Charlestown	Phase 3, A2
Fig. 17	New Washington Street, Somerville	Alt. B
Fig. 18	Community College, Charlestown	BRT
Fig. 19	Fitchburg Street, Somerville	Alt. B
Fig. 20	New Lechmere Station, Cambridge	Phase 2, BRT
Fig. 21	New Lechmere Station, Cambridge	Phase 3, B
Fig. 22	New Lechmere Station, Cambridge	Phase 3, A1 & A2
Fig. 23	First Street / Galleria, Cambridge	Phase 2, BRT
Fig. 24	Binney Street, Cambridge	Phase 3, B
Fig. 25	Kendall / MIT, Cambridge	Phase 2, BRT
Fig. 26	Kendall / MIT, Cambridge	Phase 3, A1 & A2
Fig. 27	MIT / Mass Avenue, Cambridge	Phase 2, BRT
Fig. 28	MIT / Mass Avenue, Cambridge	Phase 3, B
Fig. 29	MIT / Mass Avenue, Cambridge	Phase 3, A1 & A2
Fig. 30	Cambridgeport, Cambridge	Phase 2, BRT
Fig. 31	Cambridgeport, Cambridge	Phase 3, B
Fig. 32	BU / St. Mary's, Brookline	Phase 2, BRT
Fig. 33	BU / St. Mary's, Brookline	Phase 3, B
Fig. 34	Kenmore / Yawkey, Boston	Phase 2, BRT
Fig. 35	Kenmore / Yawkey, Boston	Phase 3, A1 & A2
Fig. 36	Brookline Ave. / Fenway, Boston	Phase 2, BRT
Fig. 37	Brookline Ave. / Fenway, Boston	Phase 3, A1 & A2
Fig. 38	Longwood / Louis Pasteur, Boston	Phase 2, BRT
Fig. 39	Longwood / Louis Pasteur, Boston	Phase 3, A1, A2 & B
Fig. 40	Fenway / Louis Pasteur, Boston	Phase 2, BRT
Fig. 41	Ruggles Street / Green Line E, Boston	BRT
Fig. 42	Ruggles / Whittier St., Boston	Phase 2, BRT
Fig. 43	Ruggles / Whittier St., Boston	Phase 3, A1, A2 & B
Fig. 44	Dudley Square, Roxbury	Phase 2, BRT
Fig. 45	Dudley Square, Roxbury	Phase 3, A1, A2 & B
Fig. 46	Washington Street / Silver Line, Boston	BRT, Option A
Fig. 47	Washington Street / Silver Line, Boston	BRT, Option B
Fig. 48	Washington Street / Silver Line, Boston	BRT, Option C
Fig. 49	Blue Hill Avenue, Roxbury	BRT
Fig. 50	Uphams Corner, North Dorchester	BRT
Fig. 51	Edward Everett Square, South Boston	BRT
Fig. 52	JFK / Umass, South Boston	BRT
Fig. 53	Umass Campus / South Boston	BRT
Fig. 54	Crosstown / Albany Street, Boston	BRT
Fig. 55	Biosquare, Boston	BRT
Fig. 56	Convention Center, South Boston	BRT

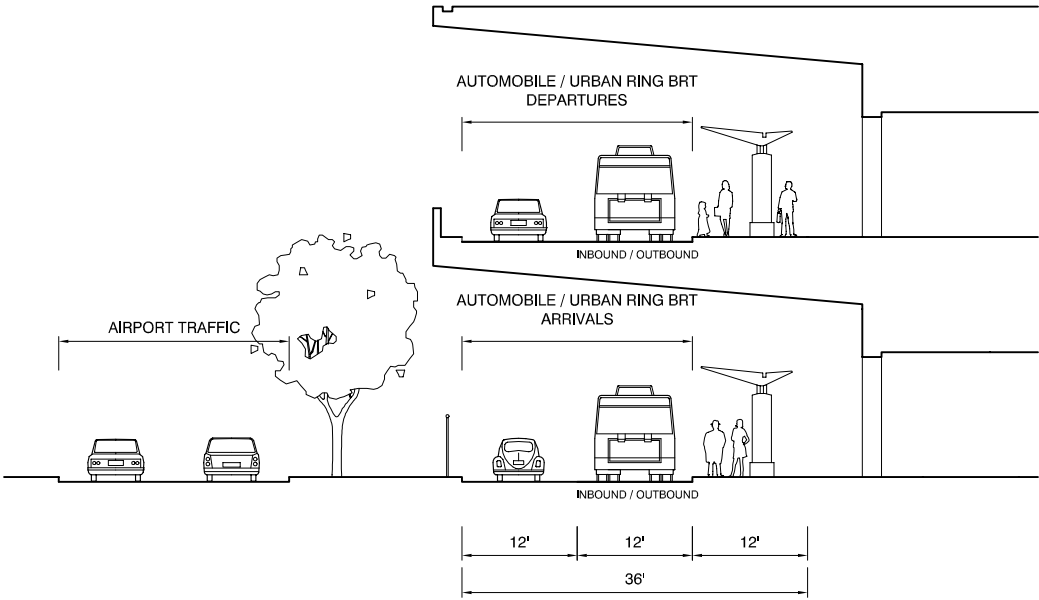


FIGURE 1
LOGAN TERMINALS URBAN RING STATION BRT
SCALE 1:20 ADJACENT BLUE LINE STATION - TYPICAL SECTION - SECTION LOOKING EAST

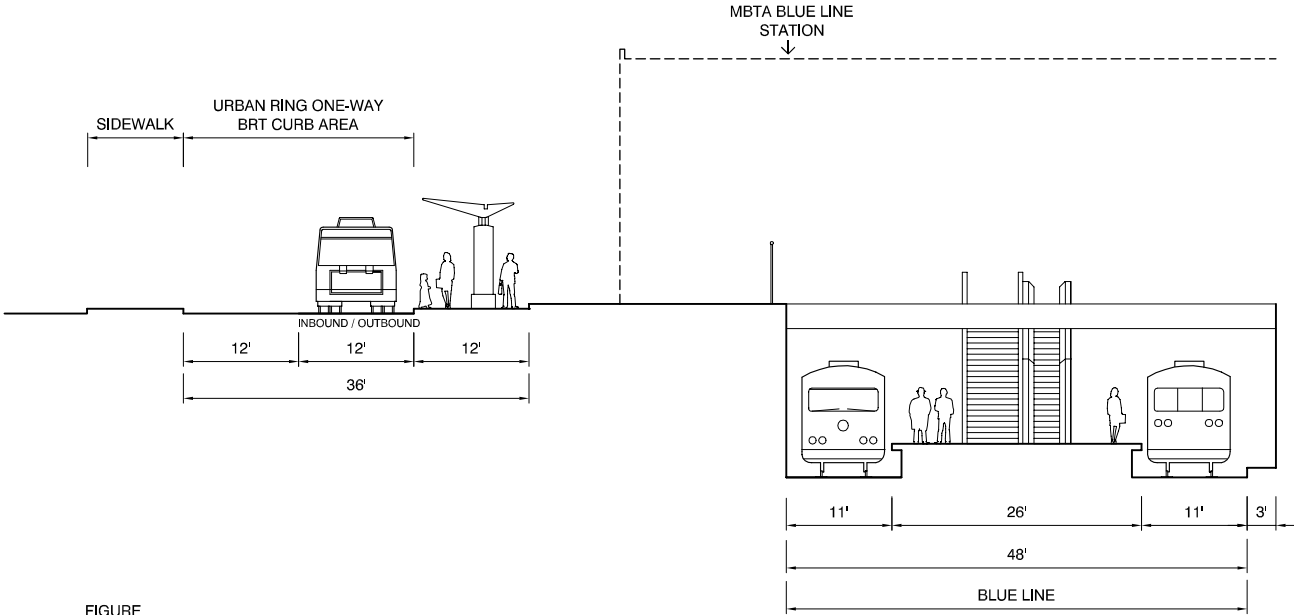


FIGURE 2
AIRPORT BLUE LINE URBAN RING STATION BRT
SCALE 1:20 ADJACENT BLUE LINE STATION - SECTION LOOKING SOUTH

Please Note: Station graphics are conceptual only. Actual station locations and configurations will be determined in subsequent environmental and design phases.

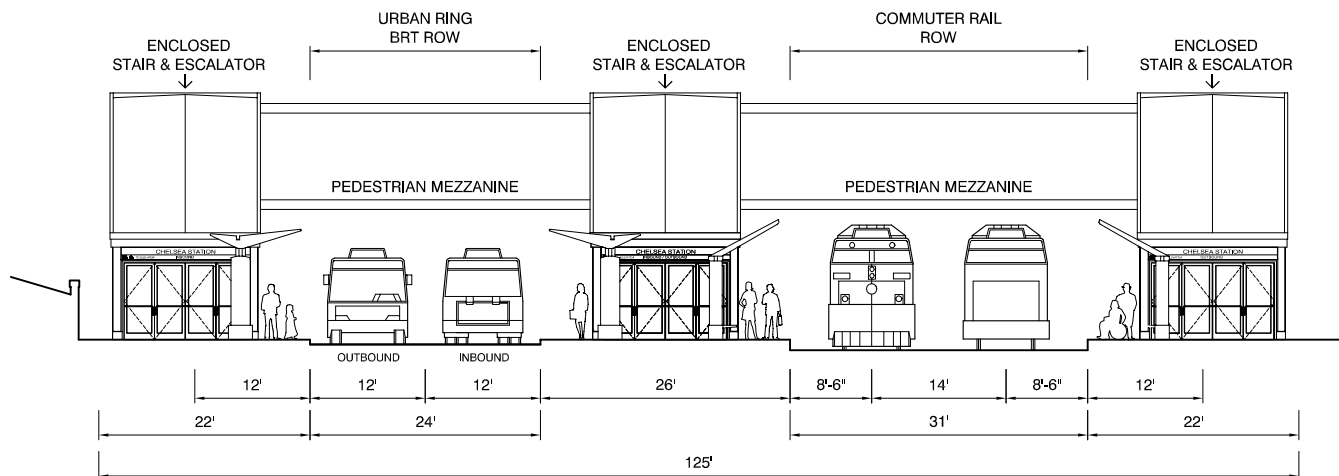


FIGURE 3
CHelsea COMMUTER RAIL STATION BRT
SCALE 1:20 ADJACENT TO COMMUTER RAIL ROW - SECTION LOOKING WEST

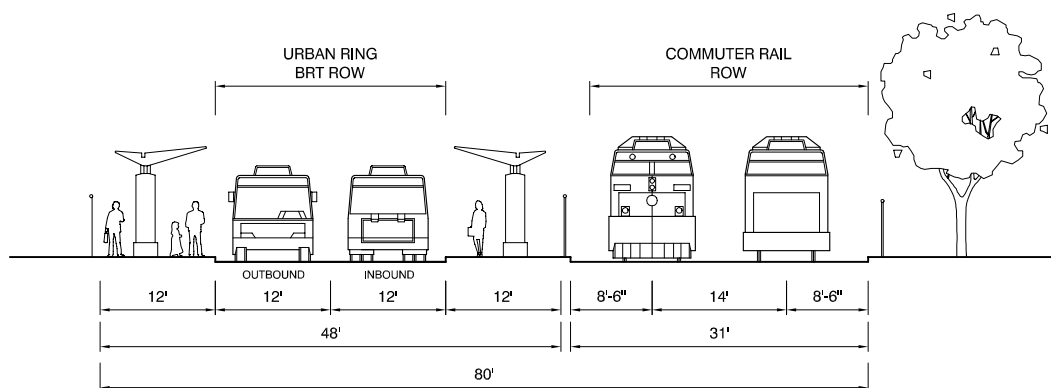


FIGURE 4
EVERETT AVENUE URBAN RING STATION BRT
SCALE 1:20 ADJACENT COMMUTER RAIL ROW - SECTION LOOKING WEST

Please Note: Station graphics are conceptual only. Actual station locations and configurations will be determined in subsequent environmental and design phases.

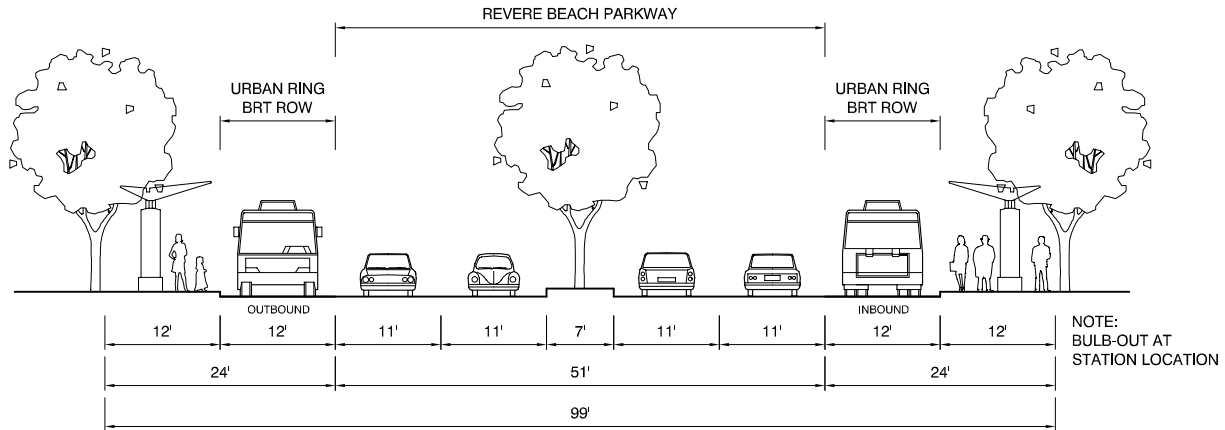


FIGURE 5 REVERE BEACH PARKWAY URBAN RING STATION BRT
SCALE 1:20 SECTION LOOKING WEST

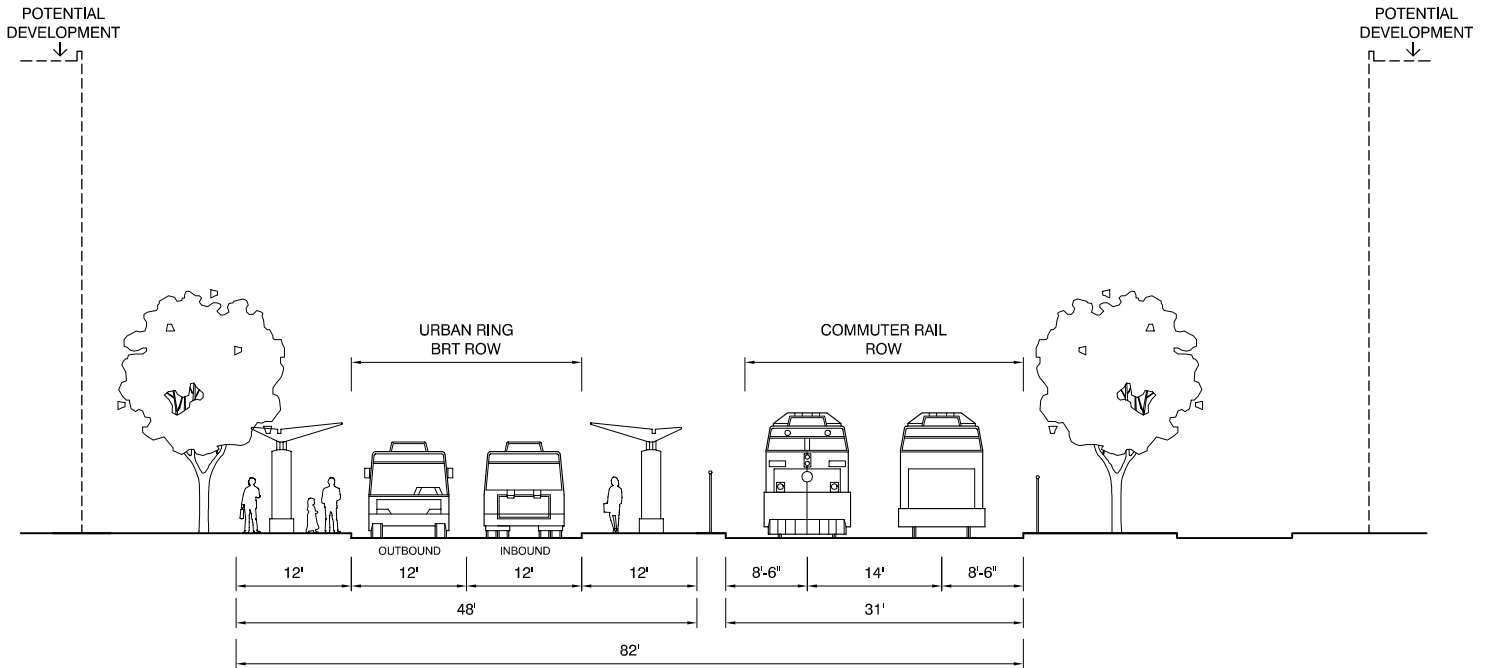


FIGURE 6 SECOND STREET URBAN RING STATION BRT
SCALE 1:20 ALONG COMMUTER RAIL ROW - SECTION LOOKING WEST

Please Note: Station graphics are conceptual only. Actual station locations and configurations will be determined in subsequent environmental and design phases.

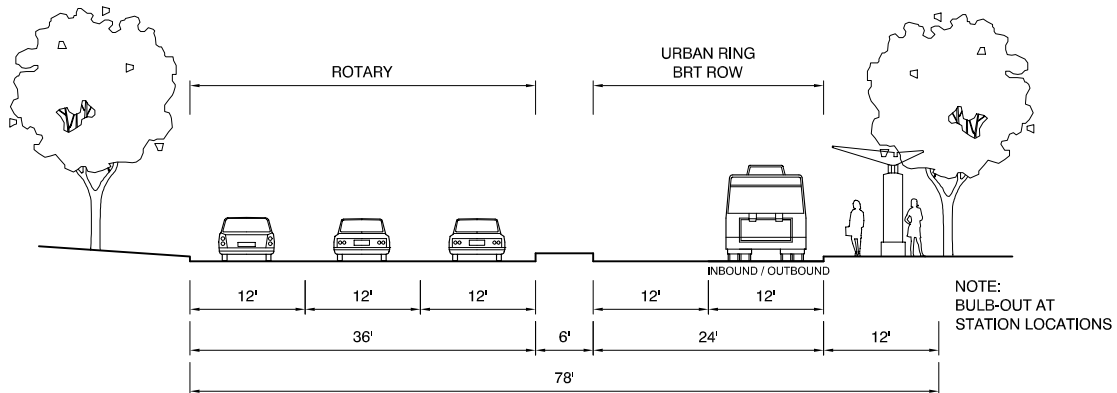


FIGURE 7
BROADWAY URBAN RING STATION BRT
SCALE 1:20 ALONG RT99 - REVERE BEACH PARKWAY ROTARY - SECTION LOOKING WEST

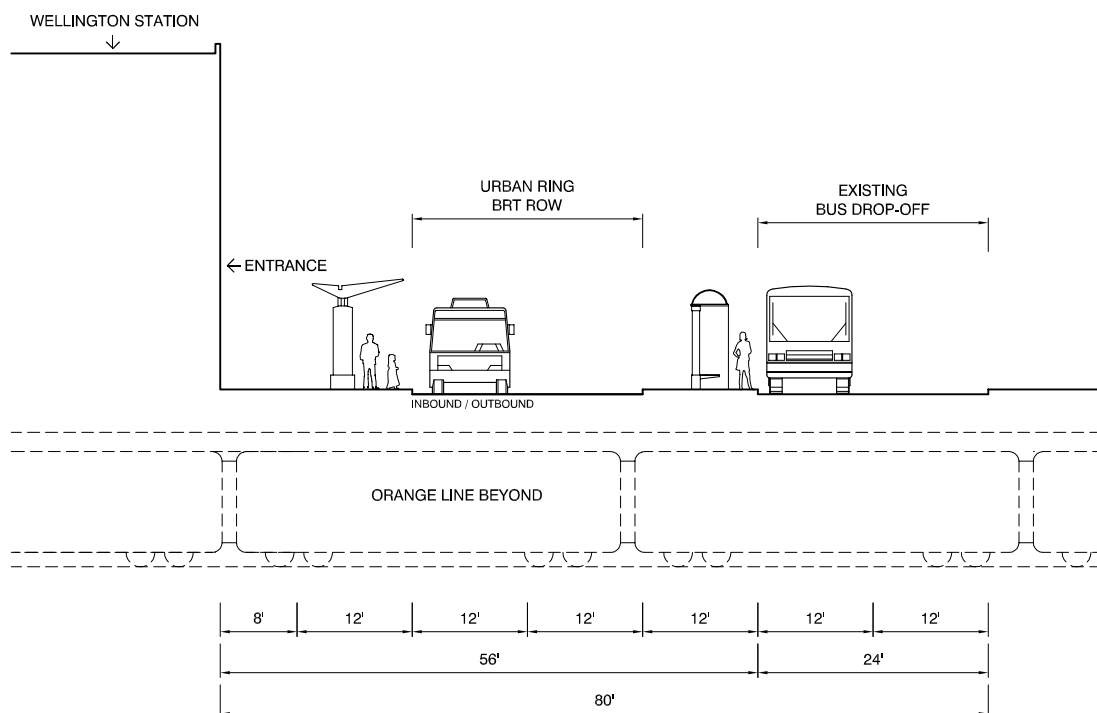


FIGURE 8
WELLINGTON URBAN RING STATION BRT
SCALE 1:20 ADJACENT EXISTING BUS DROP-OFF - SECTION LOOKING WEST

Please Note: Station graphics are conceptual only. Actual station locations and configurations will be determined in subsequent environmental and design phases.

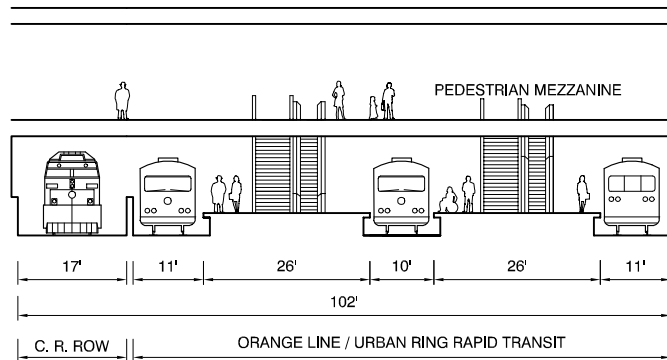


FIGURE 9
WELLINGTON URBAN RING STATION ALT. A2
SCALE 1:30 SECTION LOOKING SOUTH

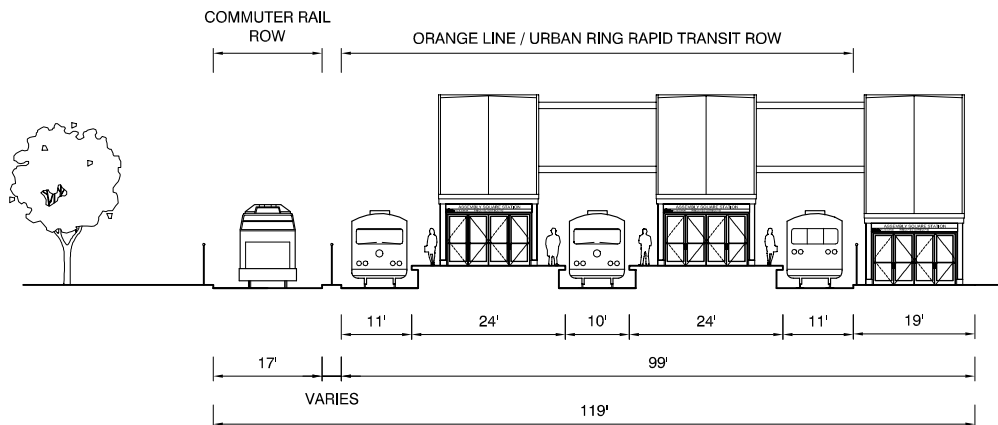


FIGURE 10
ASSEMBLY SQUARE URBAN RING STATION ALT. A2
SCALE 1:30 ADJACENT COMMUTER RAIL / ORANGE LINE ROW - SECTION LOOKING SOUTH

Please Note: Station graphics are conceptual only. Actual station locations and configurations will be determined in subsequent environmental and design phases.

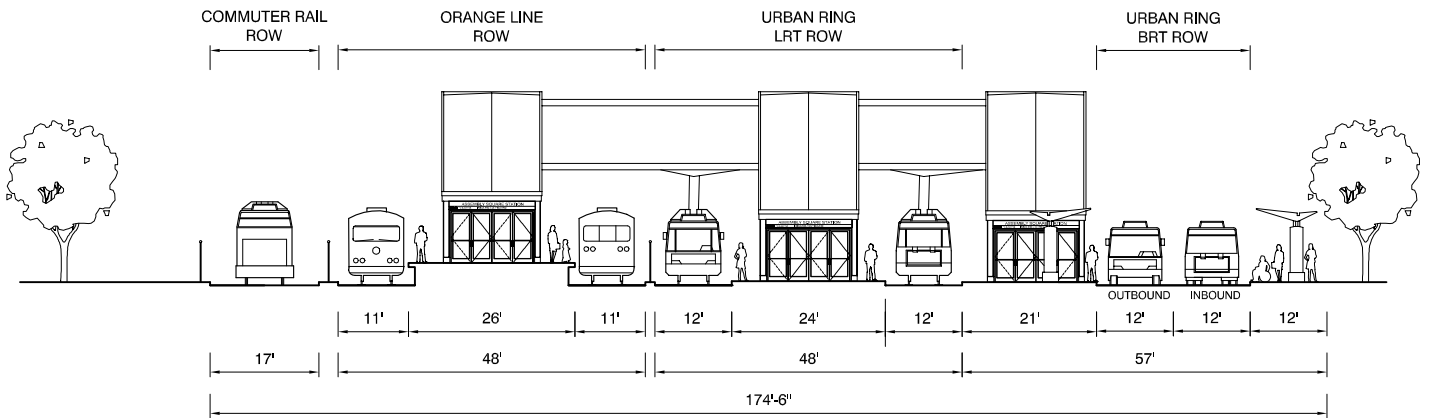


FIGURE 11
ASSEMBLY SQUARE URBAN RING STATION ALT. A1 & ALT. B
SCALE 1:30 ADJACENT COMMUTER RAIL / ORANGE LINE ROW - SECTION LOOKING SOUTH

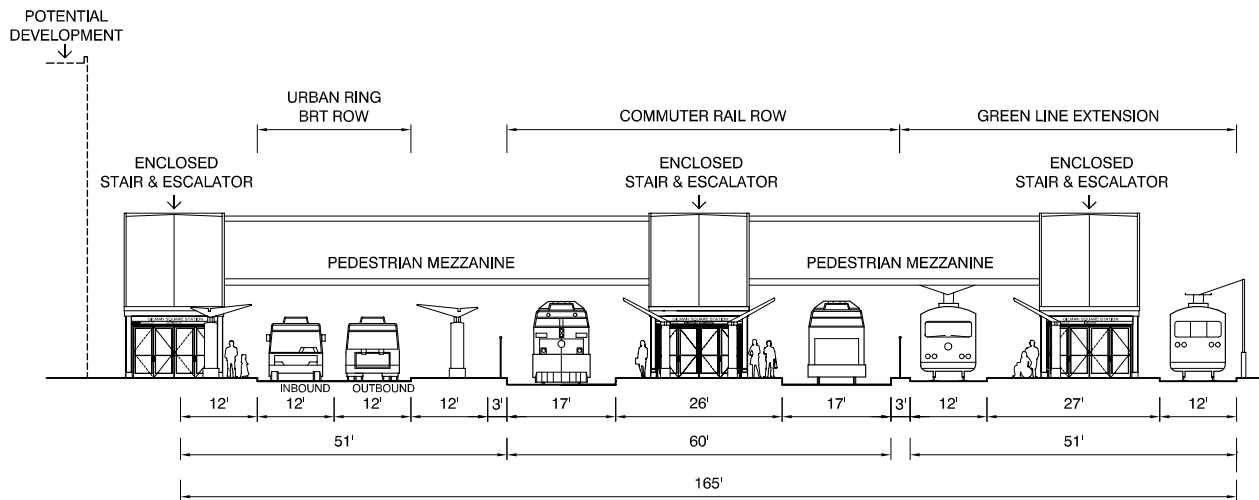


FIGURE 12
GILMAN SQUARE URBAN RING STATION BRT
SCALE 1:30 ALONG THE COMMUTER RAIL ROW - SECTION LOOKING SOUTH

Please Note: Station graphics are conceptual only. Actual station locations and configurations will be determined in subsequent environmental and design phases.

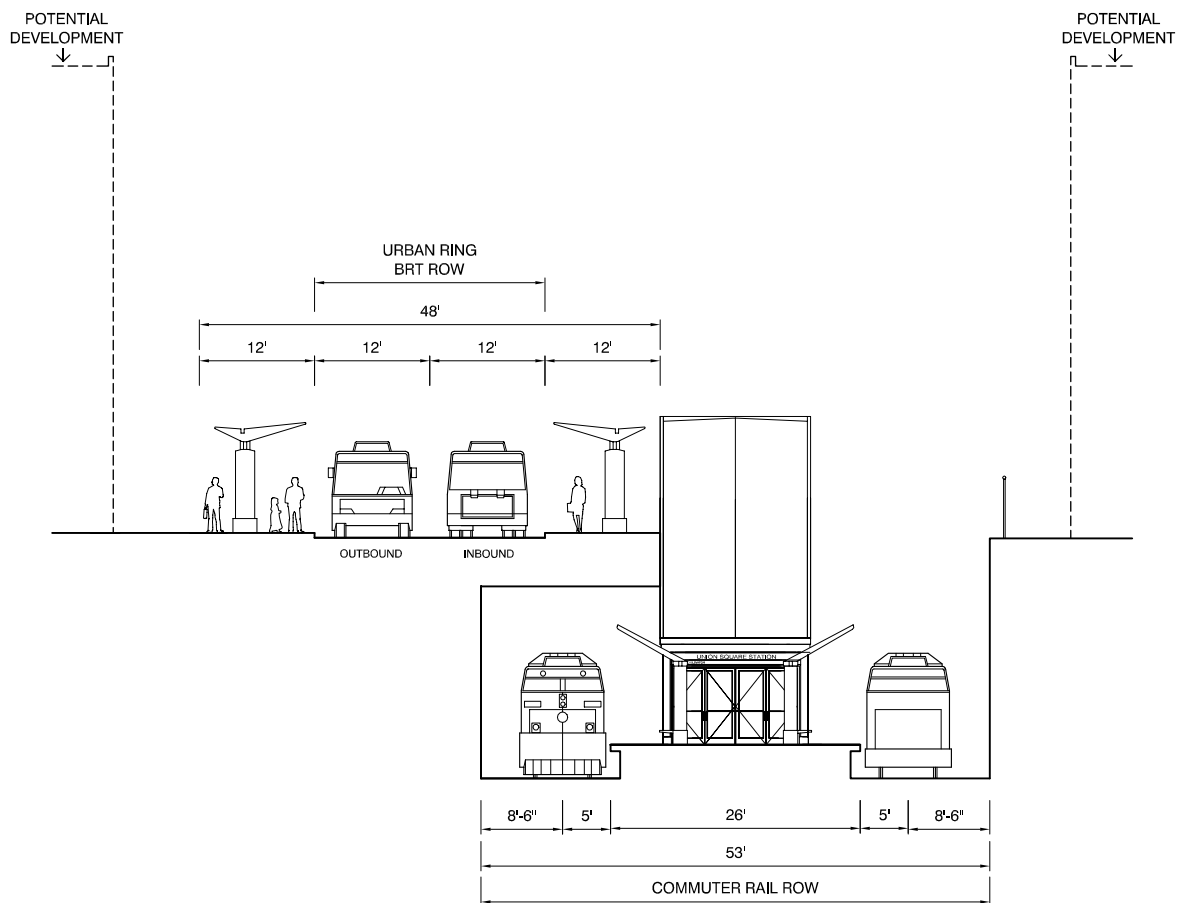


FIGURE
13 UNION SQUARE URBAN RING STATION BRT
SCALE 1:20 ADJACENT TO COMMUTER RING - SECTION LOOKING EAST

Please Note: Station graphics are conceptual only. Actual station locations and configurations will be determined in subsequent environmental and design phases.

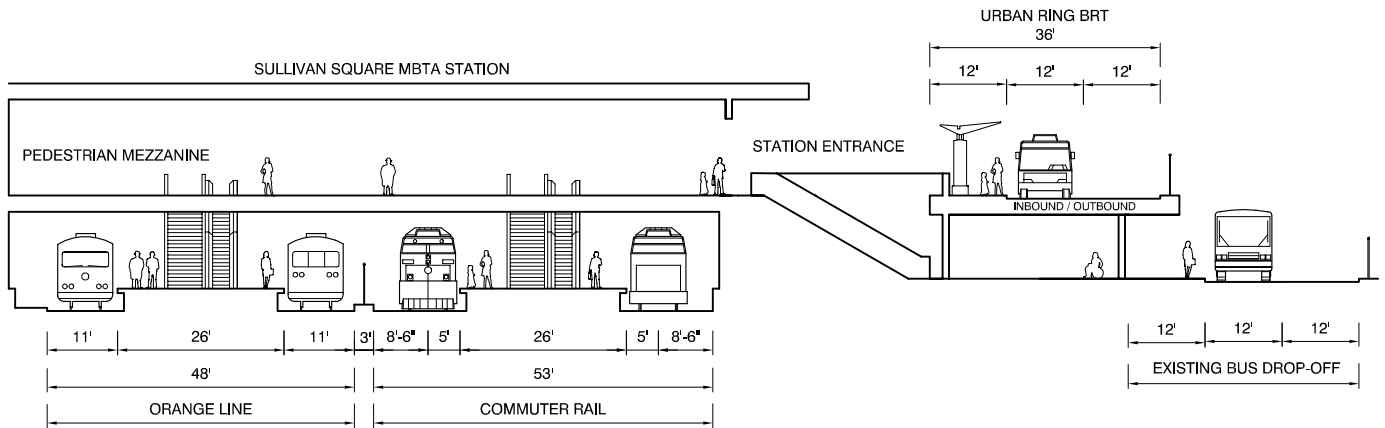


FIGURE 14 SULLIVAN SQUARE URBAN RING STATION BRT
SCALE 1:30 SECTION LOOKING NORTH

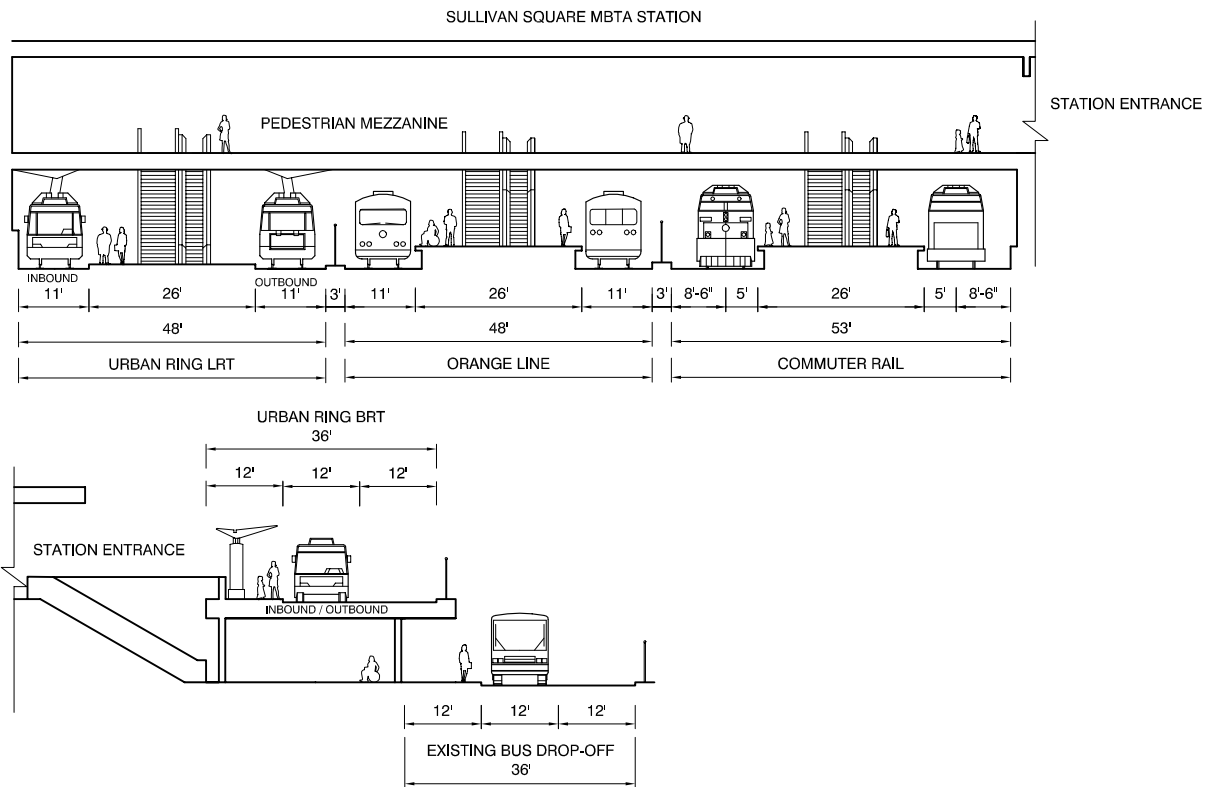


FIGURE 15 SULLIVAN SQUARE URBAN RING STATION ALT. A1 & ALT. B
SCALE 1:30 SECTION LOOKING NORTH

Please Note: Station graphics are conceptual only. Actual station locations and configurations will be determined in subsequent environmental and design phases.

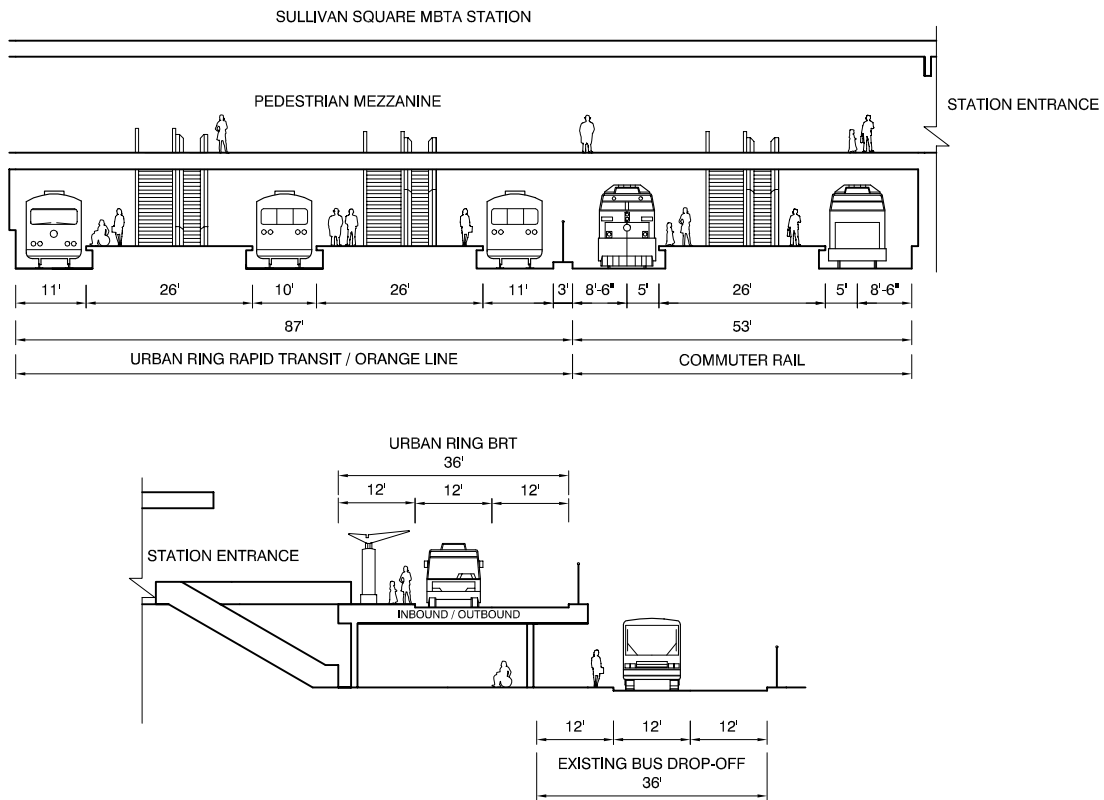
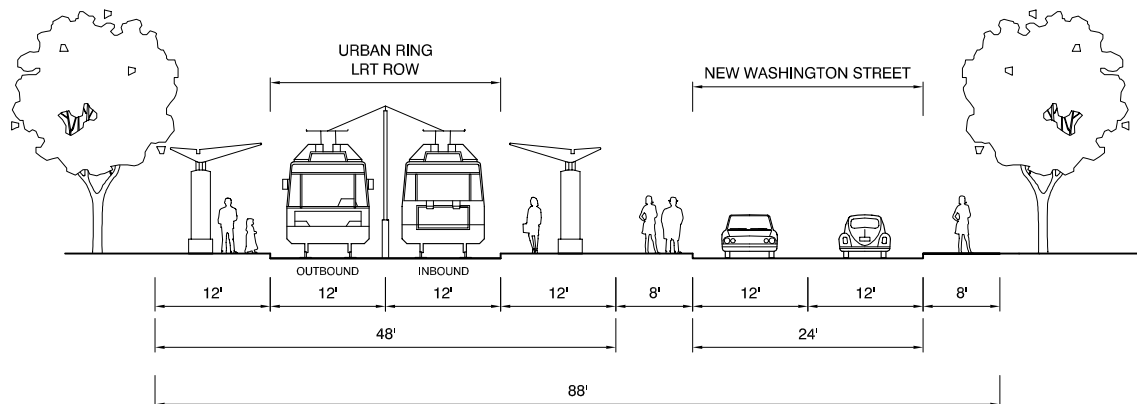


FIGURE
16 SULLIVAN SQUARE URBAN RING STATION ALT. A2
SCALE 1:30 SECTION LOOKING NORTH

Please Note: Station graphics are conceptual only. Actual station locations and configurations will be determined in subsequent environmental and design phases.



FIGURE

17

NEW WASHINGTON STREET URBAN RING STATION ALT. B

SCALE 1:20 ADJACENT TO NEW WASHINGTON STREET LOOKING WEST

Please Note: Station graphics are conceptual only. Actual station locations and configurations will be determined in subsequent environmental and design phases.

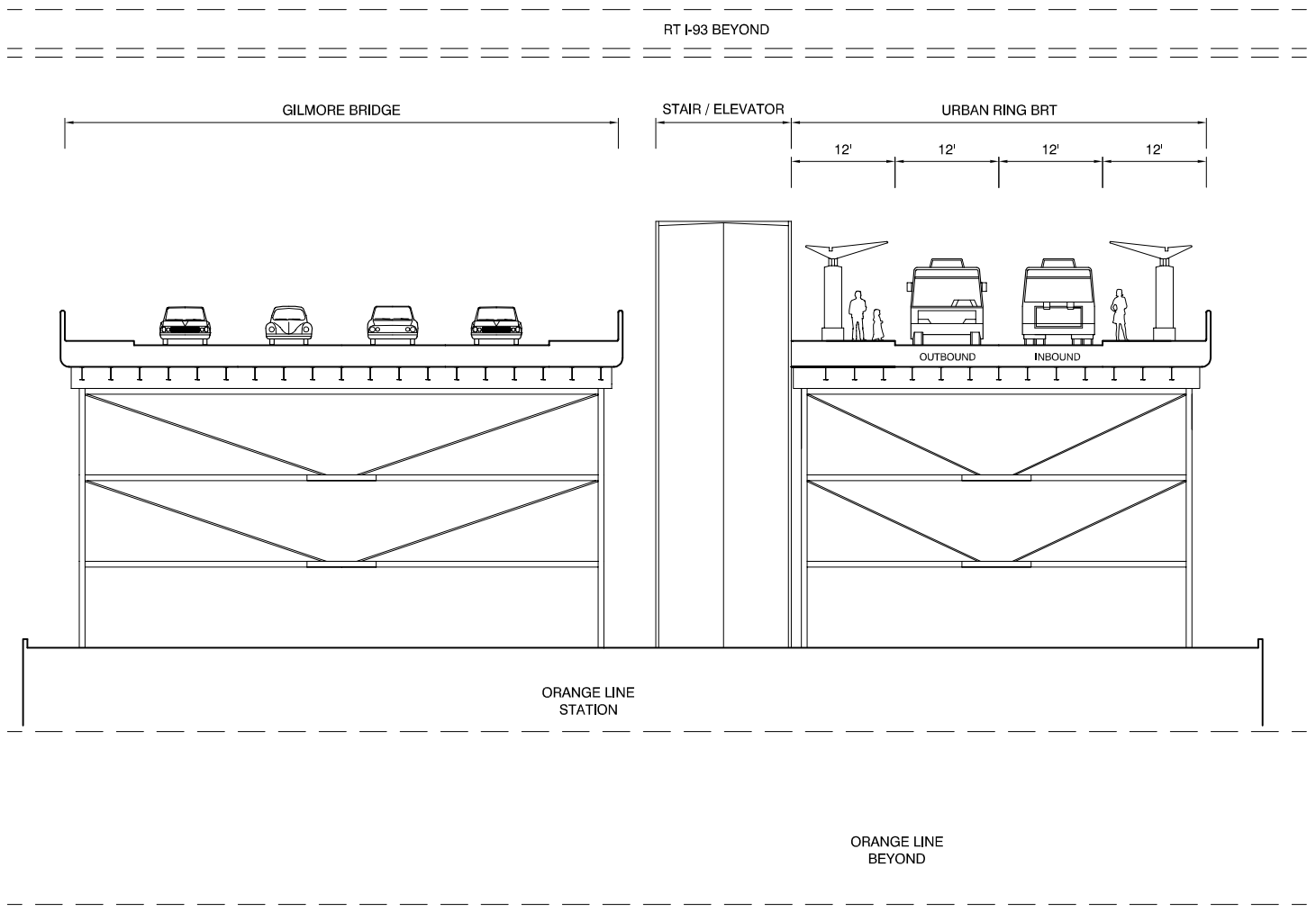


FIGURE
18 COMMUNITY COLLEGE URBAN RING STATION BRT
SCALE 1:20 SECTION LOOKING WEST

Please Note: Station graphics are conceptual only. Actual station locations and configurations will be determined in subsequent environmental and design phases.

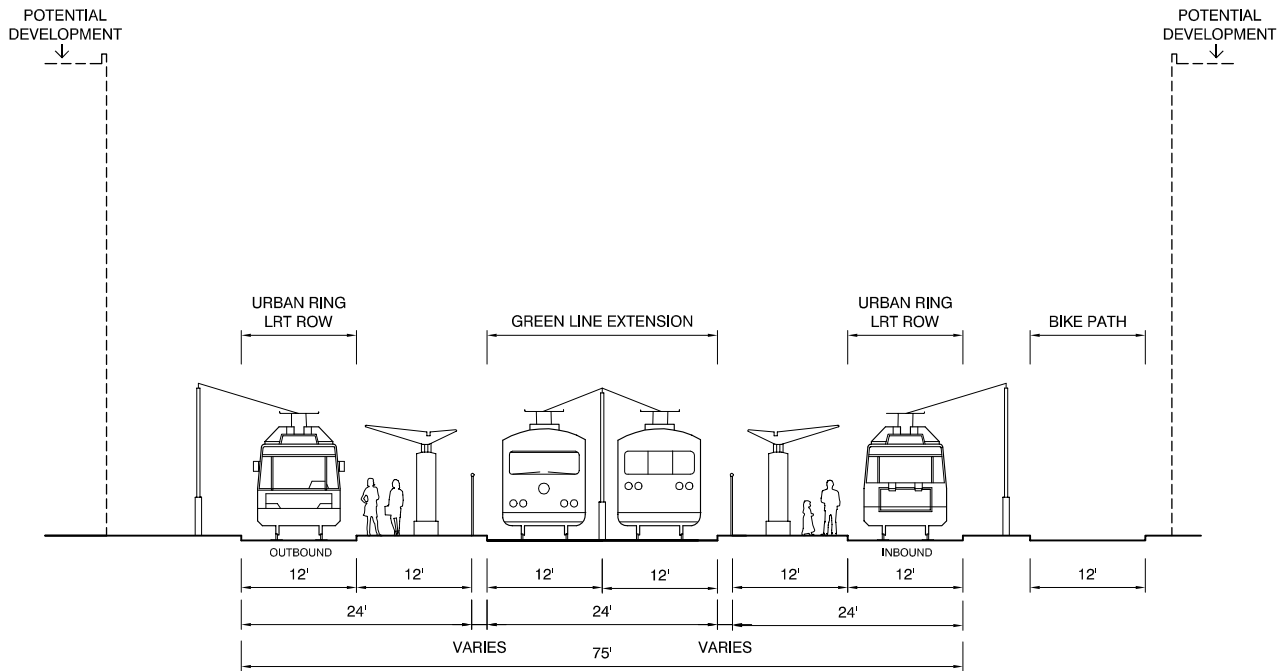


FIGURE 19
FITCHBURG STREET URBAN RING STATION ALT. B
SCALE 1:20 SECTION LOOKING EAST

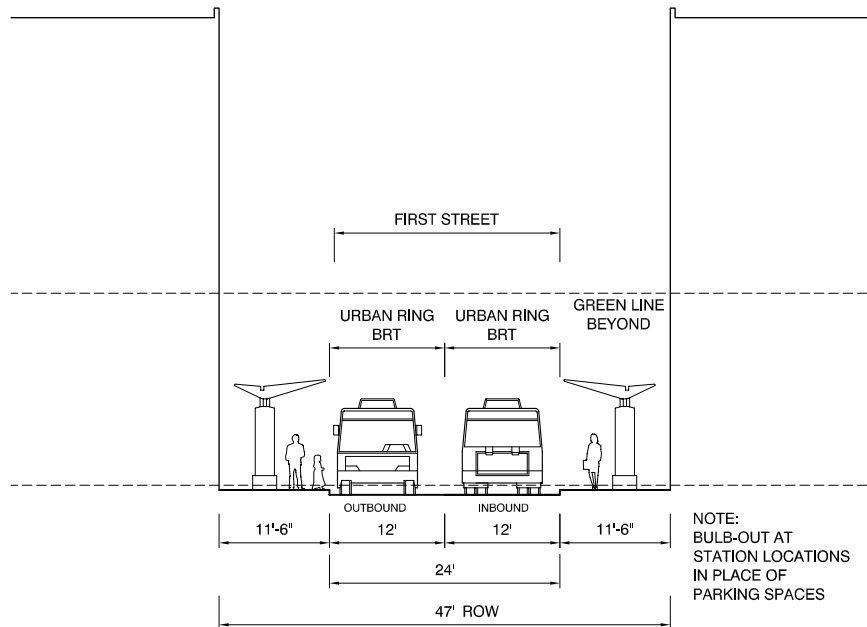
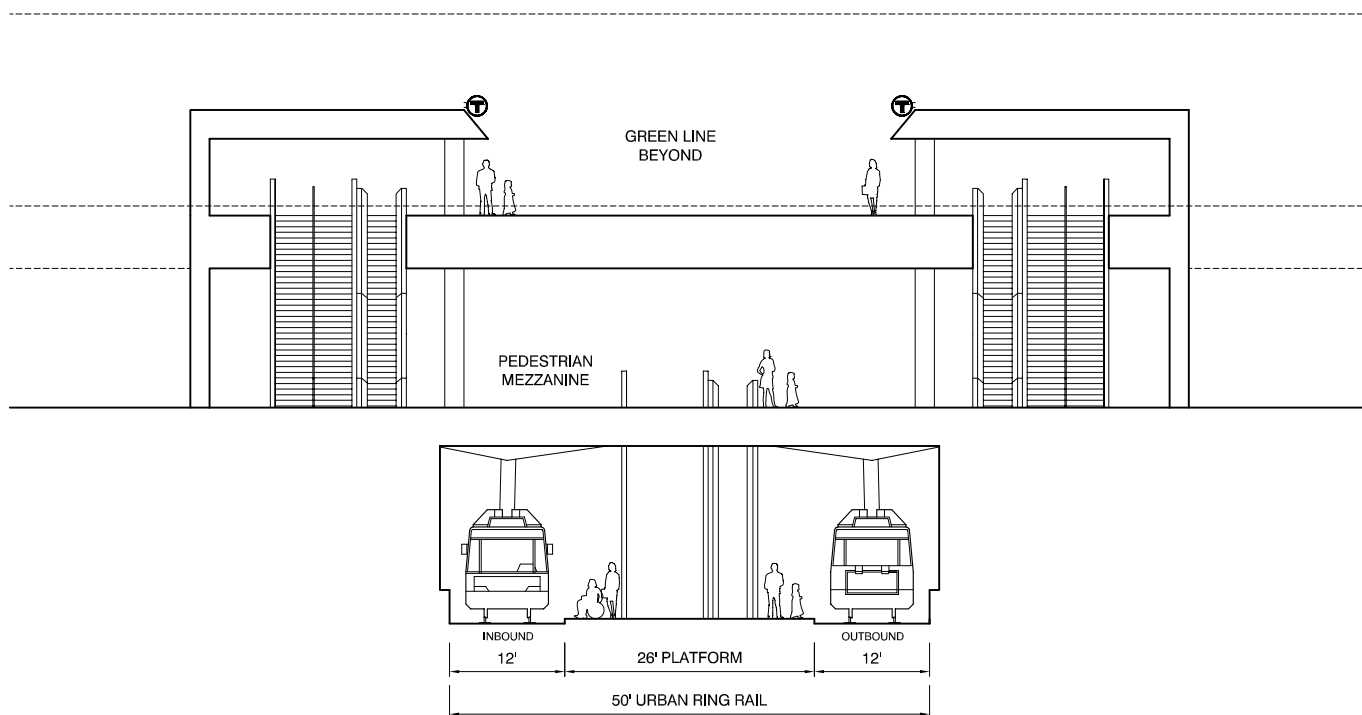


FIGURE 20
NEW LECHMERE URBAN RING STATION BRT
SCALE 1:20 SECTION LOOKING SOUTH

Please Note: Station graphics are conceptual only. Actual station locations and configurations will be determined in subsequent environmental and design phases.



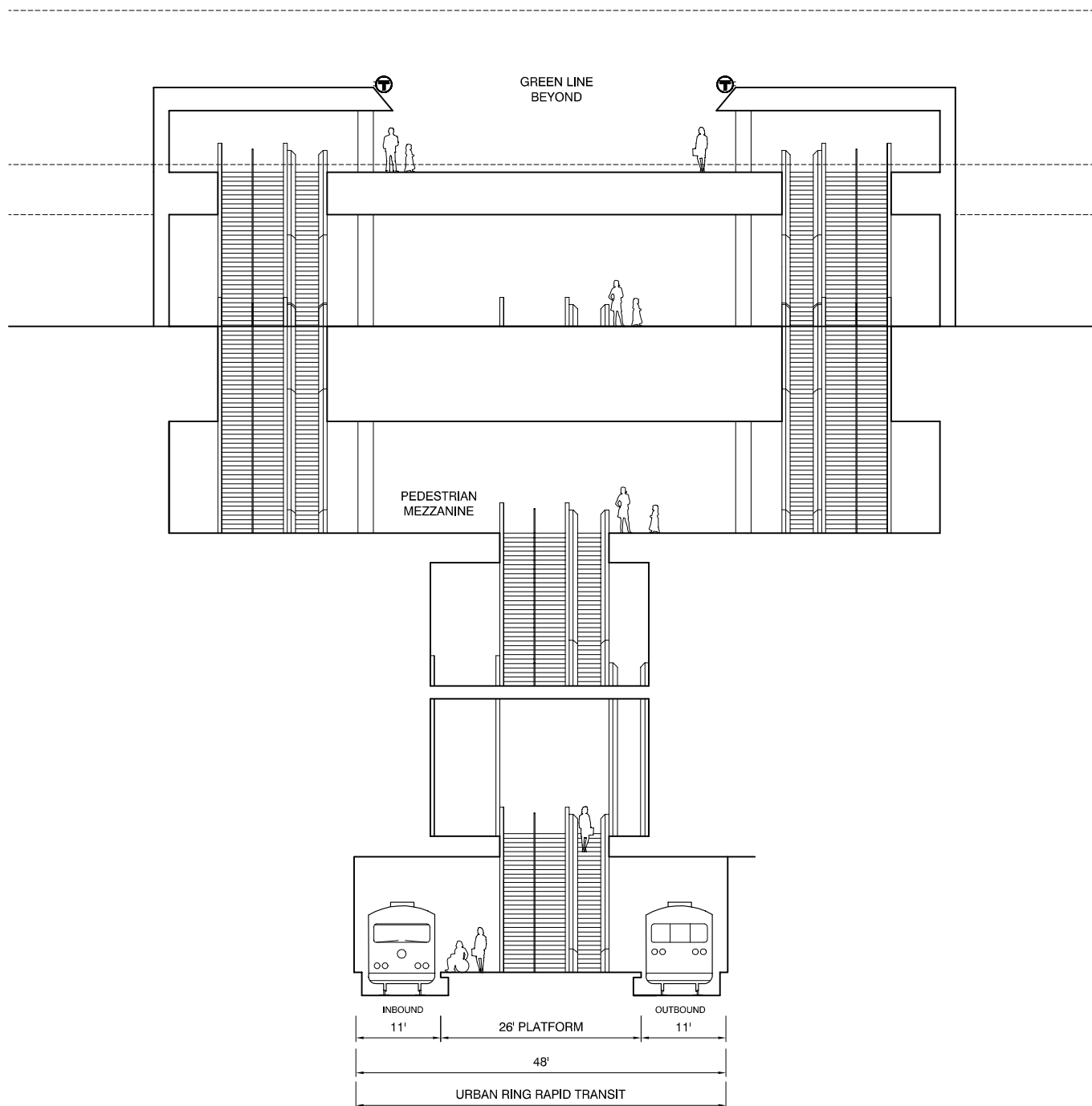
FIGURE



NEW LECHMERE SHALLOW URBAN RING STATION ALT. B

SCALE 1:20

Please Note: Station graphics are conceptual only. Actual station locations and configurations will be determined in subsequent environmental and design phases.



FIGURE



NEW LECHMERE DEEP PLATFORM CONFIGURATION URBAN RING STATION (ALT. A2 SHOWN) & ALT. A1
SCALE 1:20 SECTION LOOKING SOUTH

Please Note: Station graphics are conceptual only. Actual station locations and configurations will be determined in subsequent environmental and design phases.

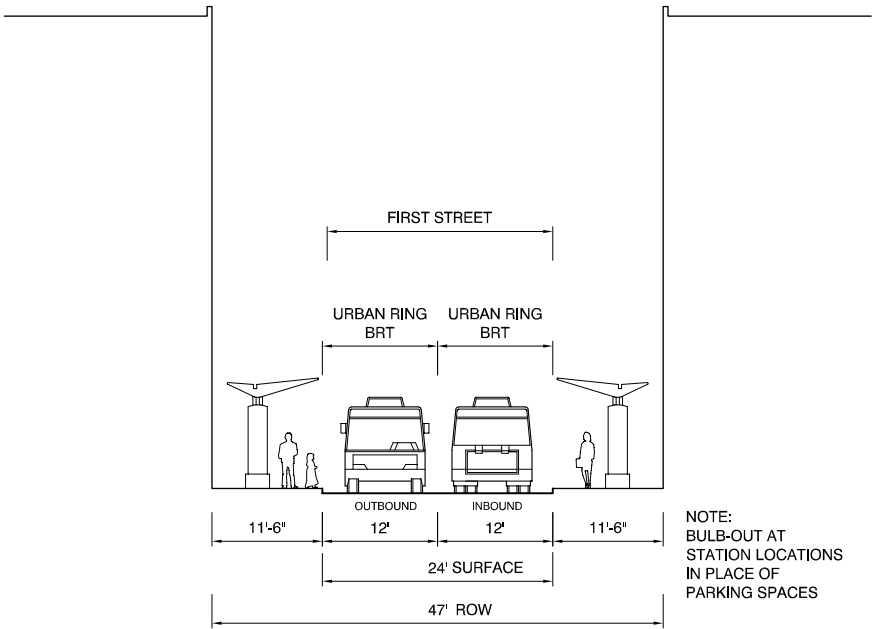


FIGURE
23 FIRST STREET / GALLERIA URBAN RING STATION BRT
SCALE 1:20 SECTION LOOKING SOUTH

Please Note: Station graphics are conceptual only. Actual station locations and configurations will be determined in subsequent environmental and design phases.

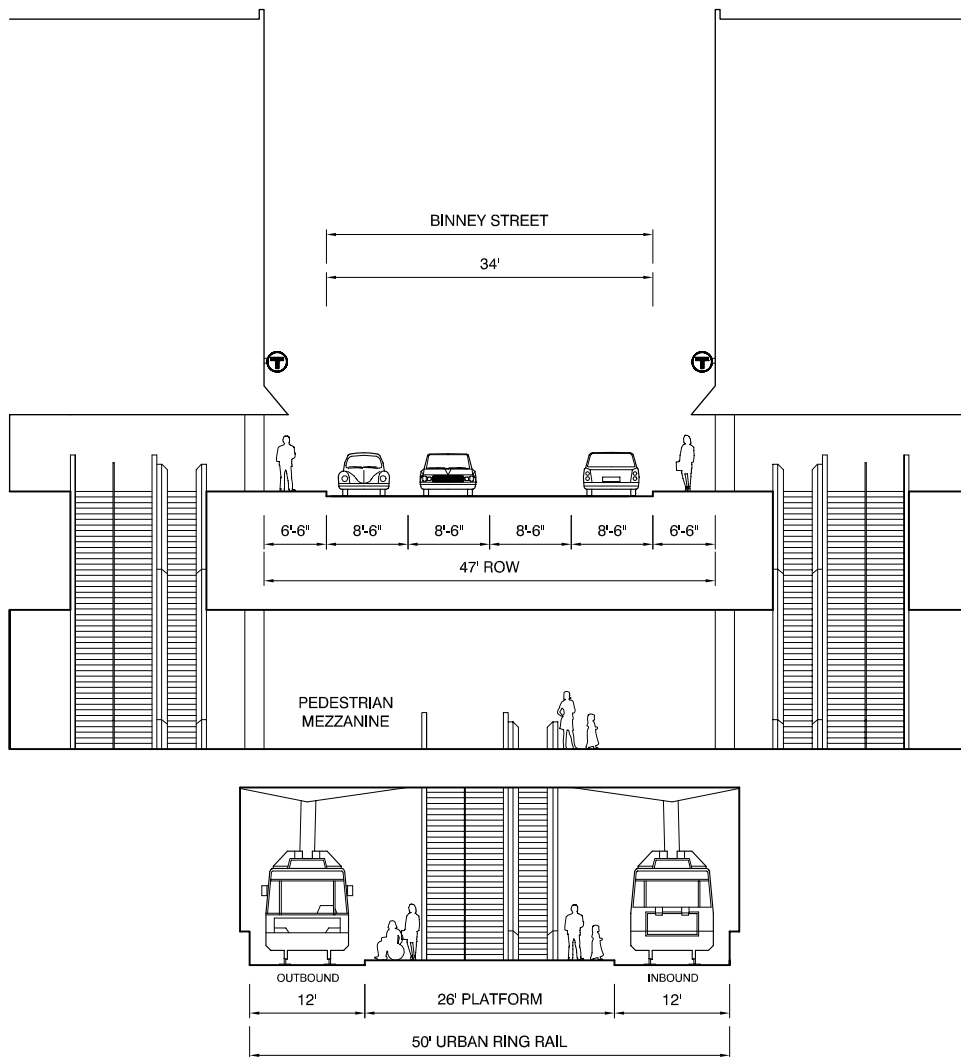


FIGURE
24 BINNEY STREET URBAN RING STATION ALT. B
SCALE 1:20 SECTION LOOKING WEST

Please Note: Station graphics are conceptual only. Actual station locations and configurations will be determined in subsequent environmental and design phases.

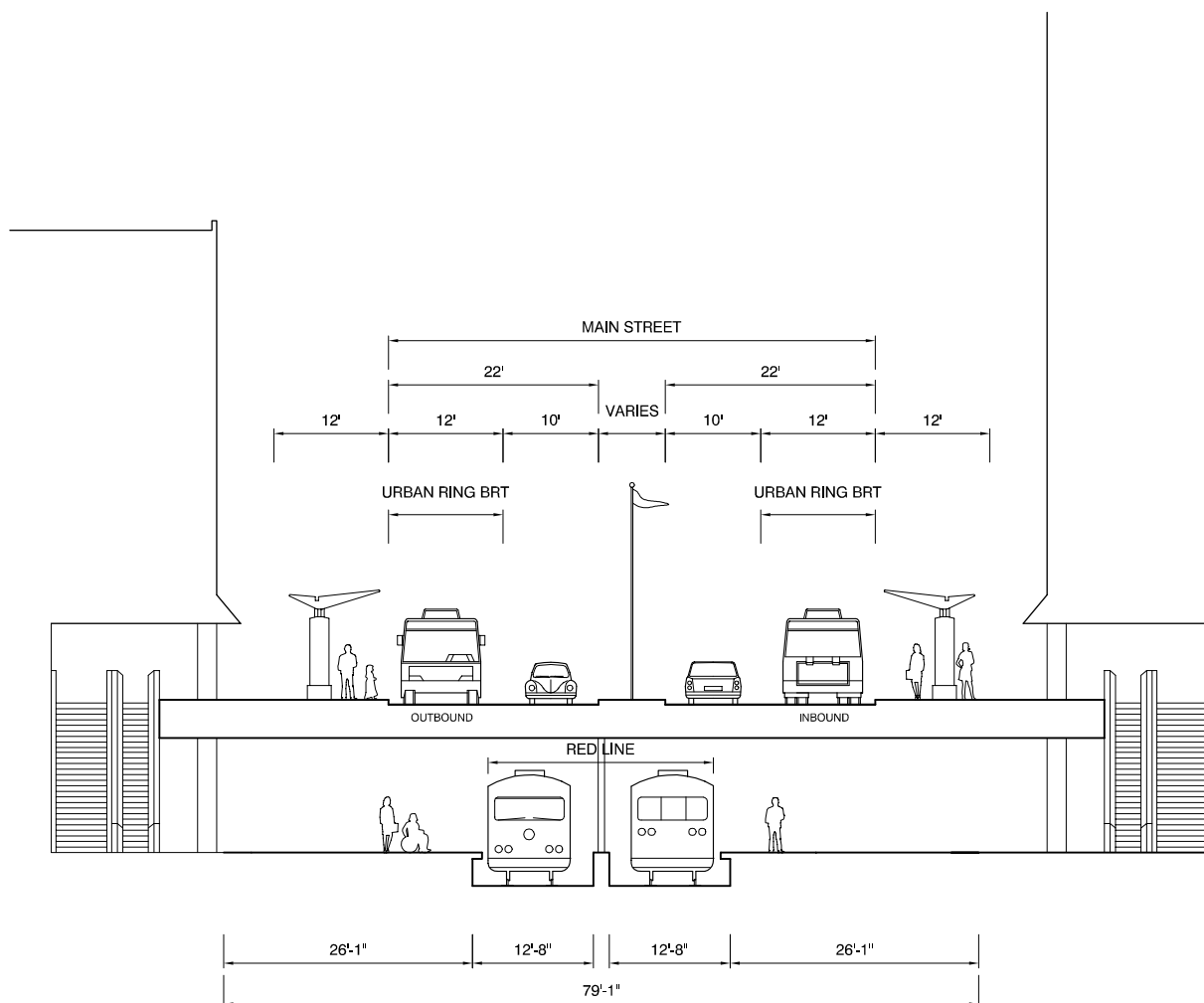


FIGURE
25 KENDALL SURFACE URBAN RING STATION BRT
SCALE 1:20 SECTION LOOKING WEST

Please Note: Station graphics are conceptual only. Actual station locations and configurations will be determined in subsequent environmental and design phases.

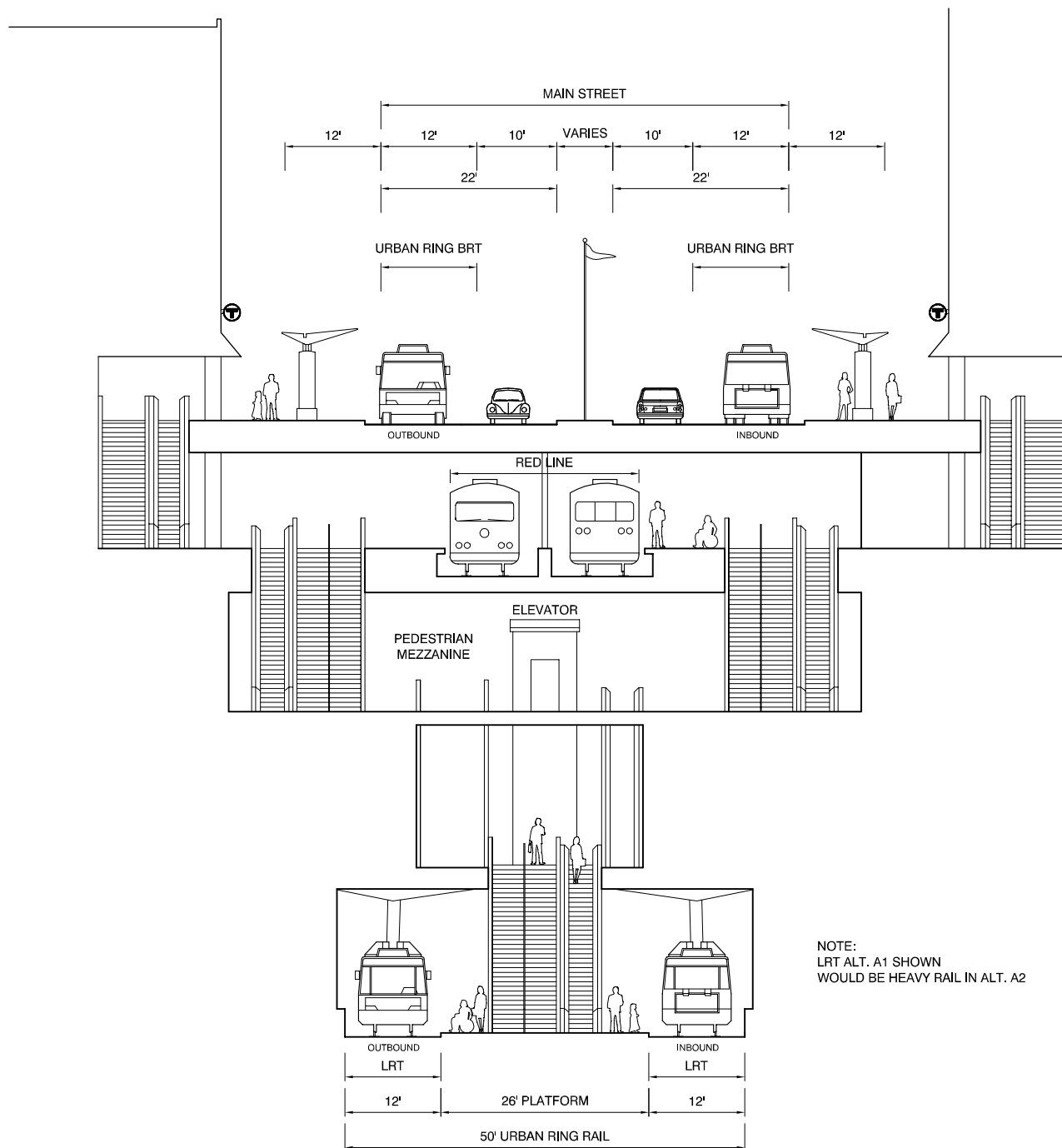


FIGURE
26 KENDALL URBAN RING STATION (ALT. A1 SHOWN) & ALT. A2
SCALE 1:20 SECTION LOOKING WEST

Please Note: Station graphics are conceptual only. Actual station locations and configurations will be determined in subsequent environmental and design phases.

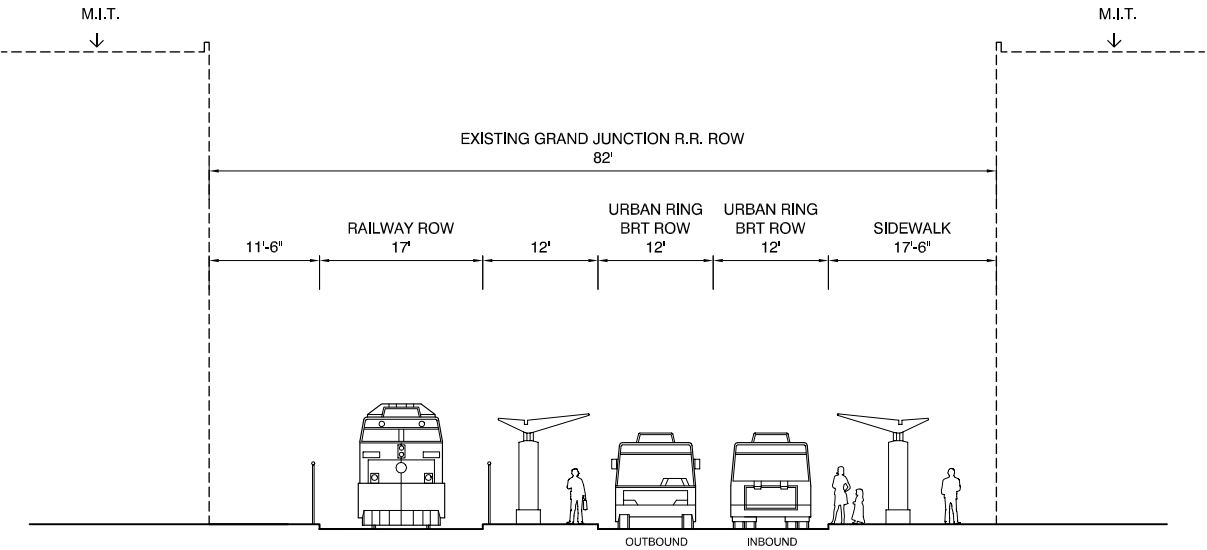


FIGURE 27 MIT / MASS. AVE. URBAN RING STATION BRT
SCALE 1:20 ADJACENT GRAND JUNCTION RAIL ROW - SECTION LOOKING EAST

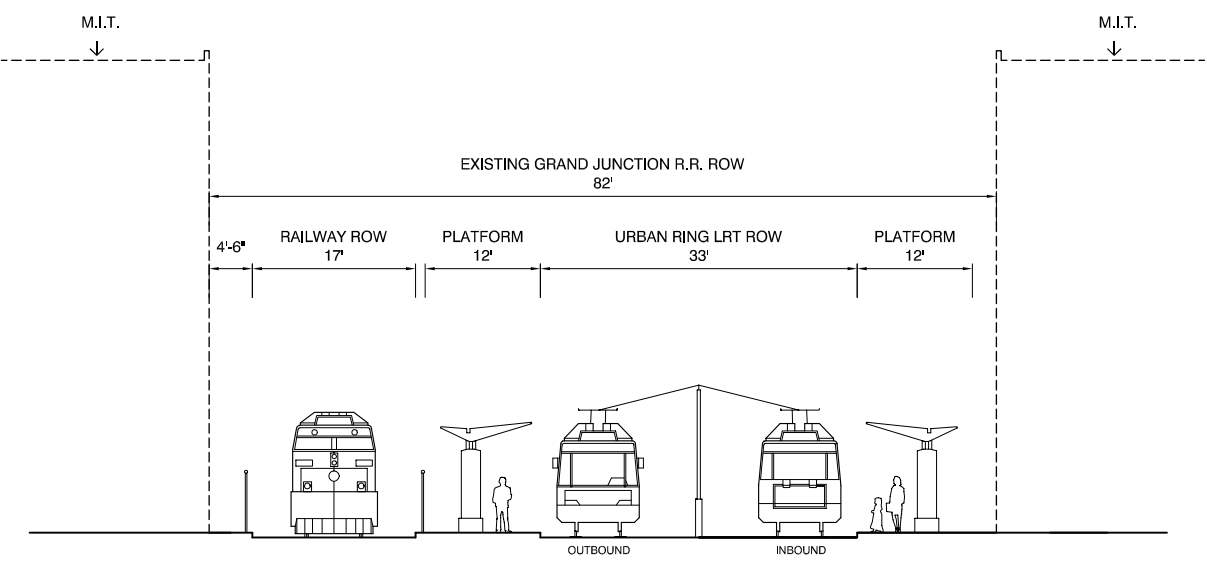


FIGURE 28 MIT / MASS. AVE. URBAN RING STATION ALT. B
SCALE 1:20 - ADJACENT GRAND JUNCTION RAIL ROW-SECTION LOOKING EAST

Please Note: Station graphics are conceptual only. Actual station locations and configurations will be determined in subsequent environmental and design phases.

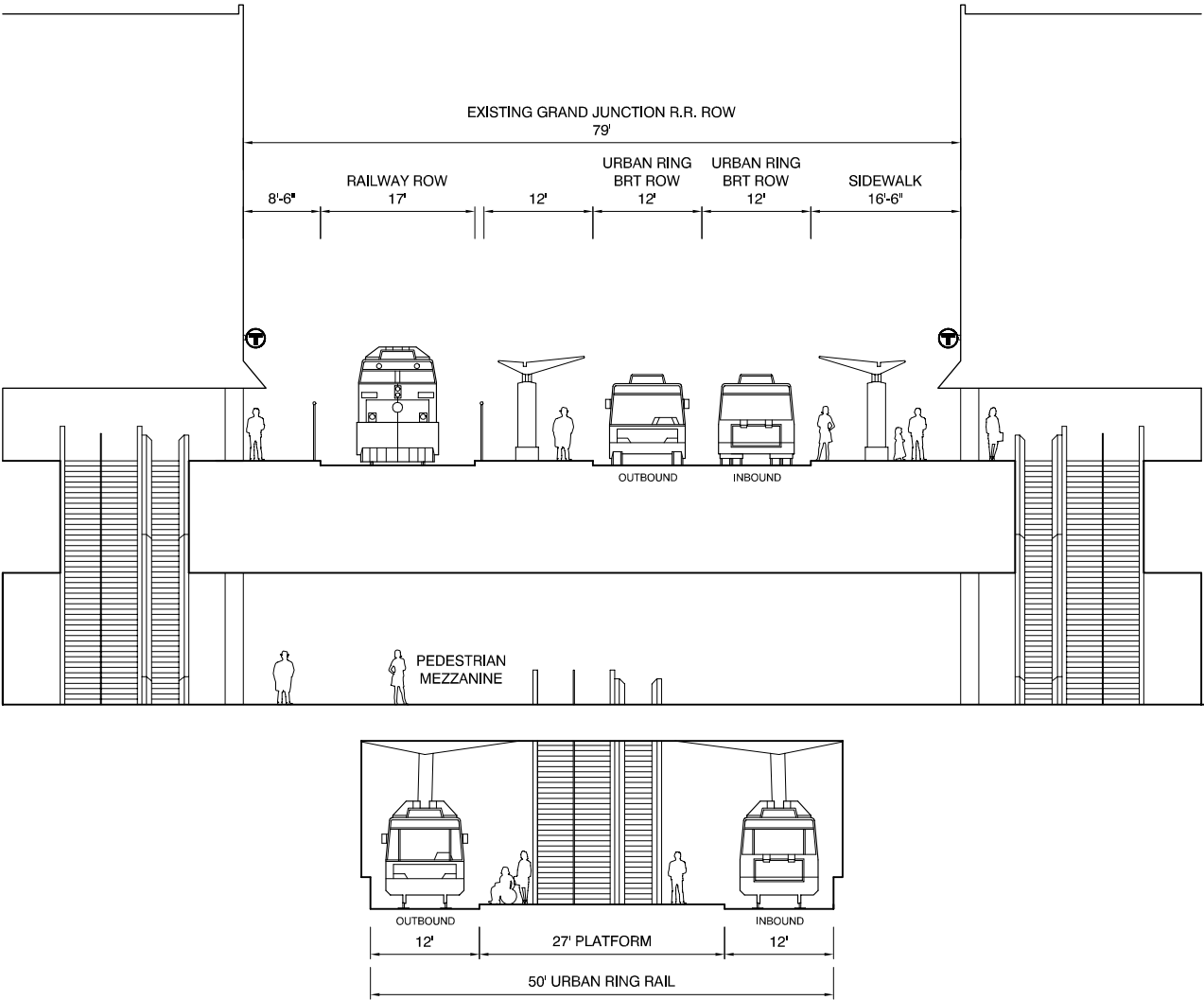


FIGURE
29 MIT / MASSACHUSETTS AVENUE URBAN RING STATION (ALT. A1 SHOWN) & ALT. A2
SCALE 1:20 SECTION LOOKING EAST

Please Note: Station graphics are conceptual only. Actual station locations and configurations will be determined in subsequent environmental and design phases.

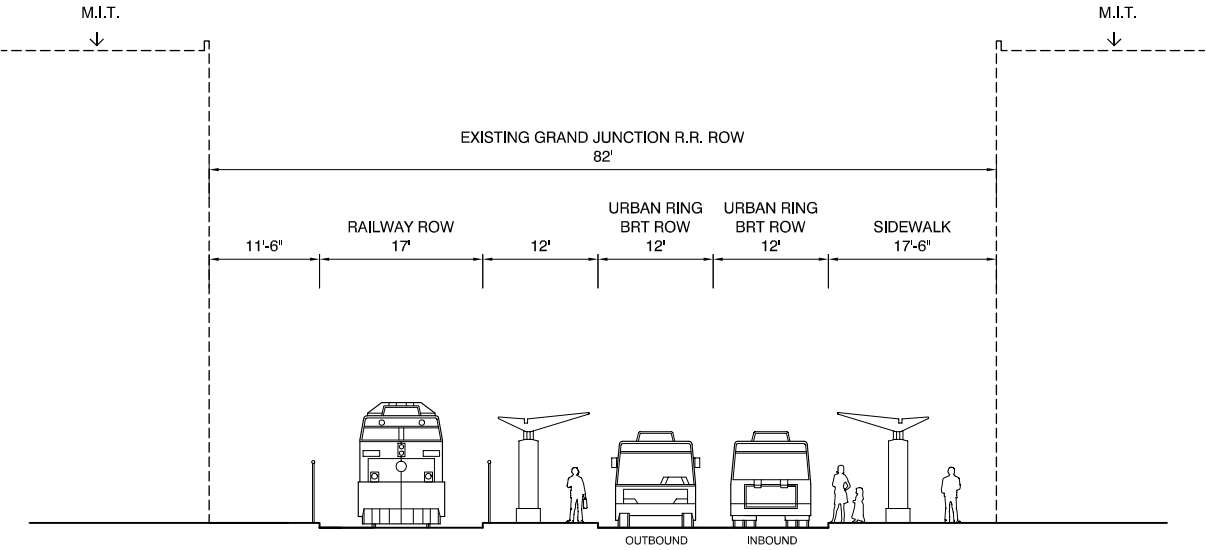


FIGURE 30
CAMBRIDGEPORT URBAN RING STATION BRT
SCALE 1:20 ADJACENT GRAND JUNCTION RAIL ROW - SECTION LOOKING EAST

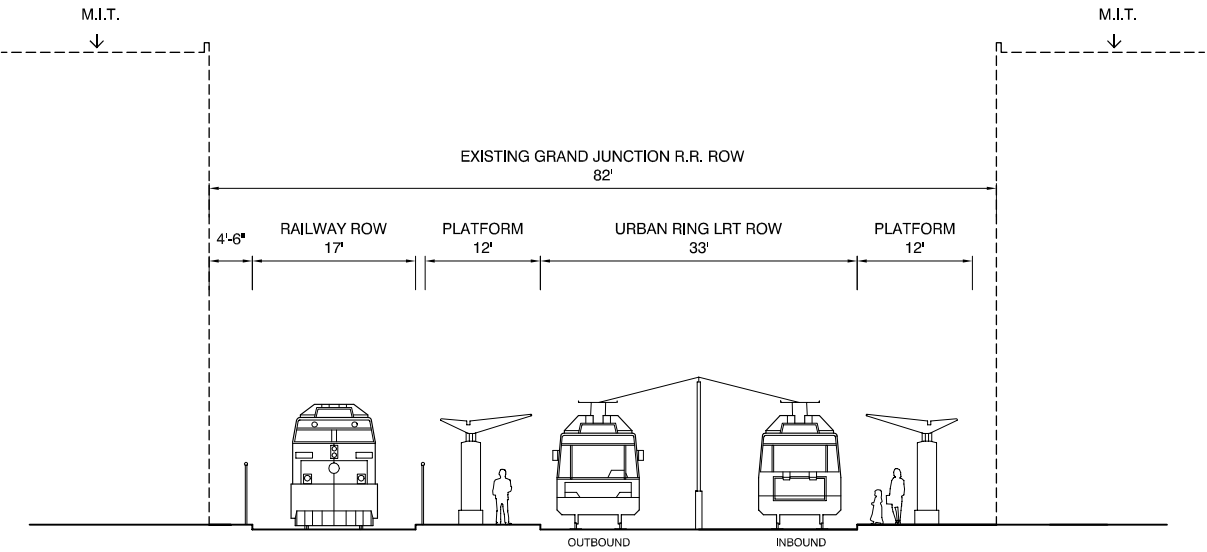
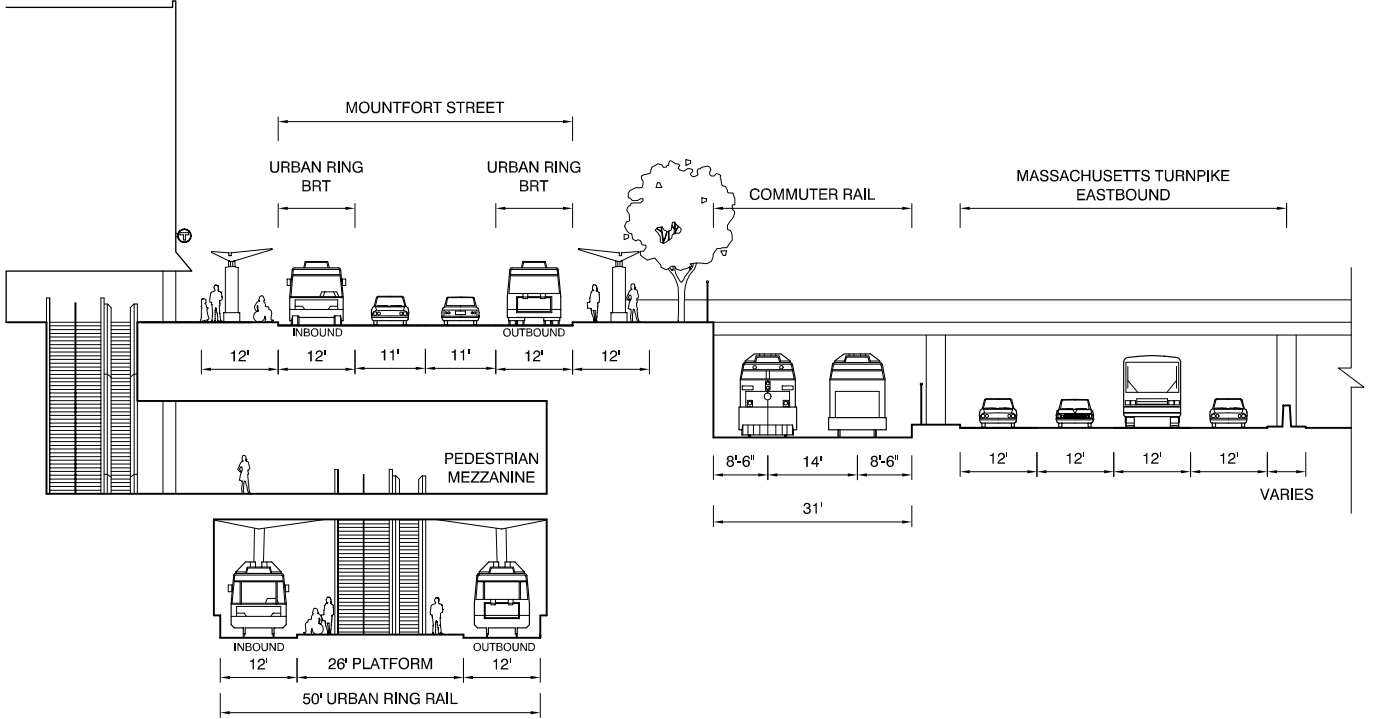
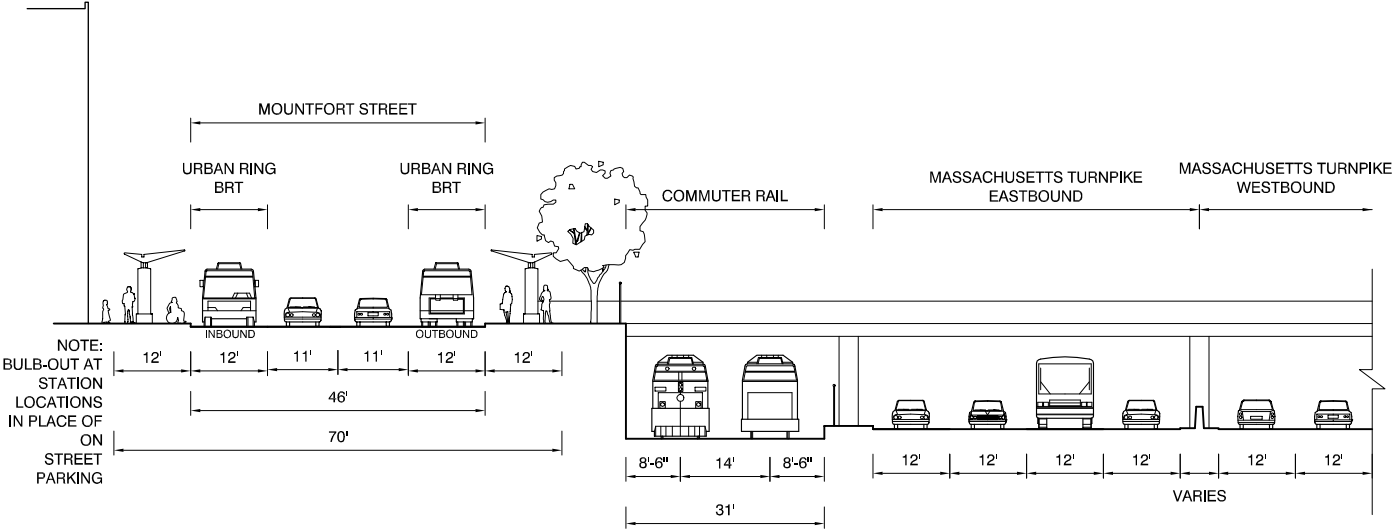


FIGURE 31
CAMBRIDGEPORT URBAN RING STATION ALT. B
SCALE 1:20 - ADJACENT GRAND JUNCTION RAIL ROW-SECTION LOOKING EAST

Please Note: Station graphics are conceptual only. Actual station locations and configurations will be determined in subsequent environmental and design phases.



Please Note: Station graphics are conceptual only. Actual station locations and configurations will be determined in subsequent environmental and design phases.

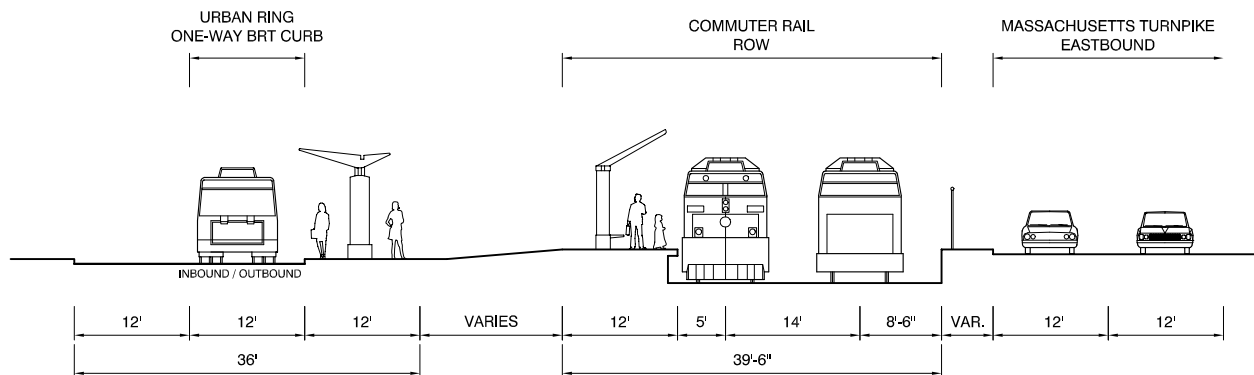


FIGURE
34 KENMORE / YAWKEY URBAN RING STATION BRT
SCALE 1:20 SECTION LOOKING WEST

Please Note: Station graphics are conceptual only. Actual station locations and configurations will be determined in subsequent environmental and design phases.

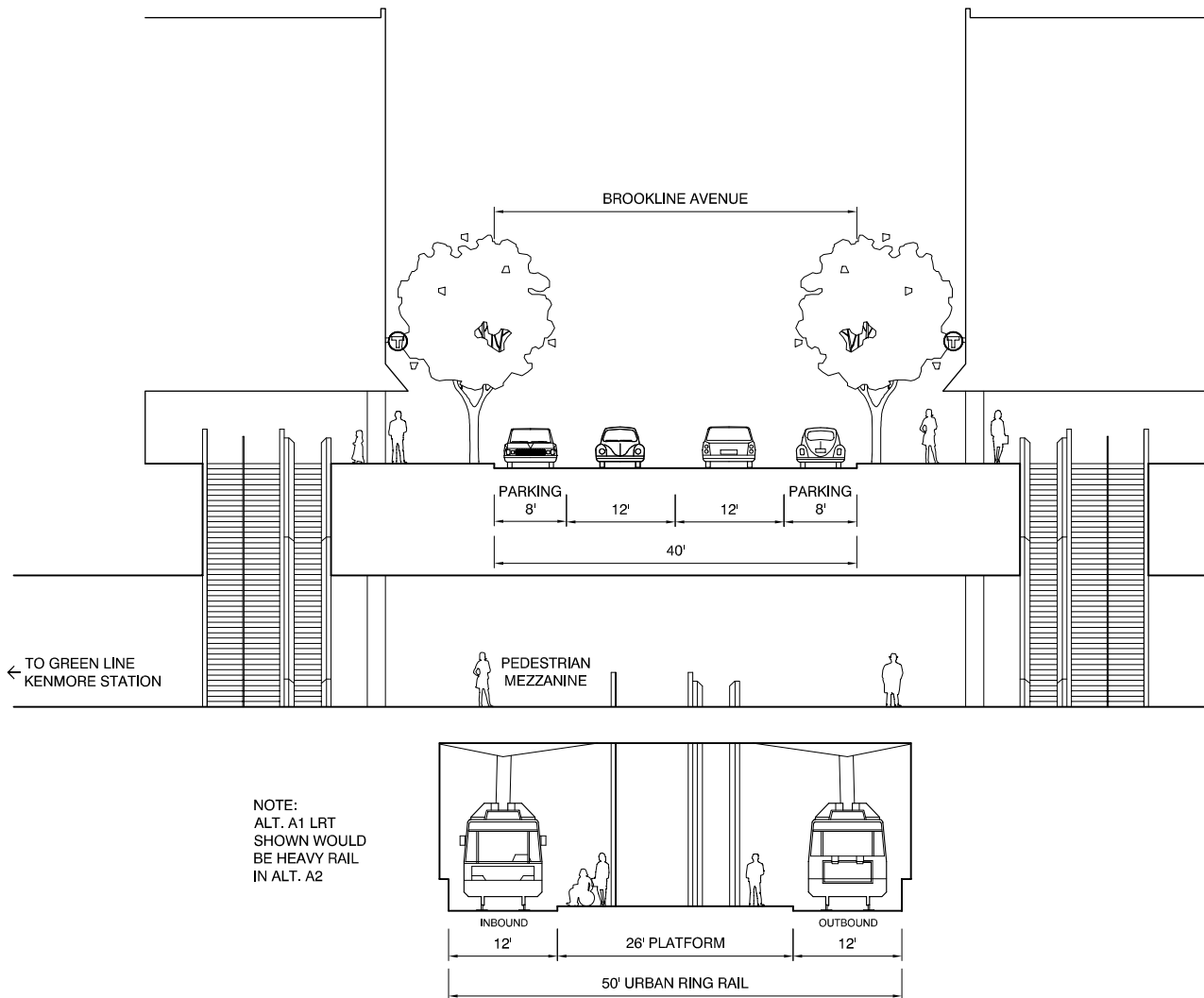


FIGURE 35 KENMORE / YAWKEY URBAN RING STATION (ALT. A1 SHOWN) & ALT. A2
SCALE 1:20 SECTION LOOKING SOUTH

Please Note: Station graphics are conceptual only. Actual station locations and configurations will be determined in subsequent environmental and design phases.

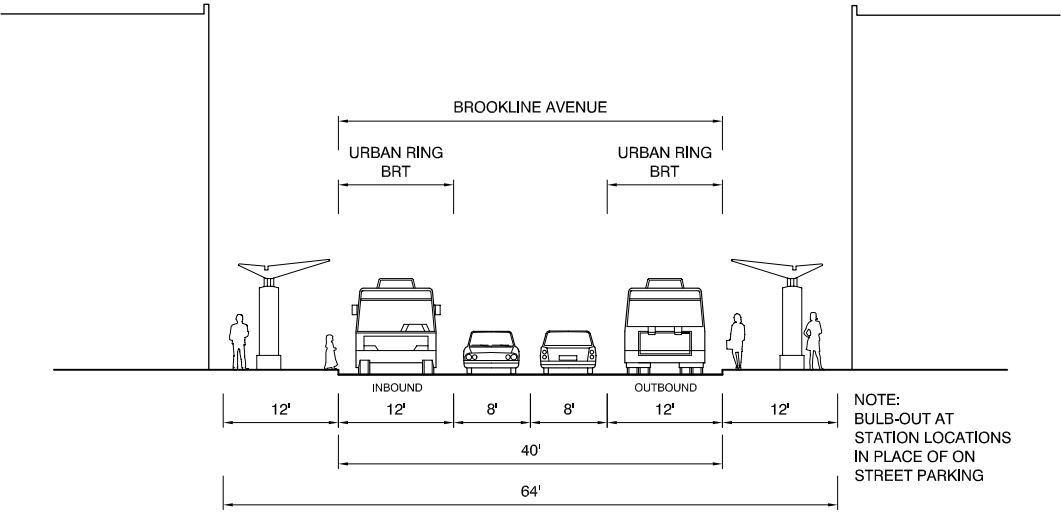


FIGURE 36
BROOKLINE AVE. / FENWAY URBAN RING STATION BRT
SCALE 1:20 SECTION LOOKING WEST

Please Note: Station graphics are conceptual only. Actual station locations and configurations will be determined in subsequent environmental and design phases.

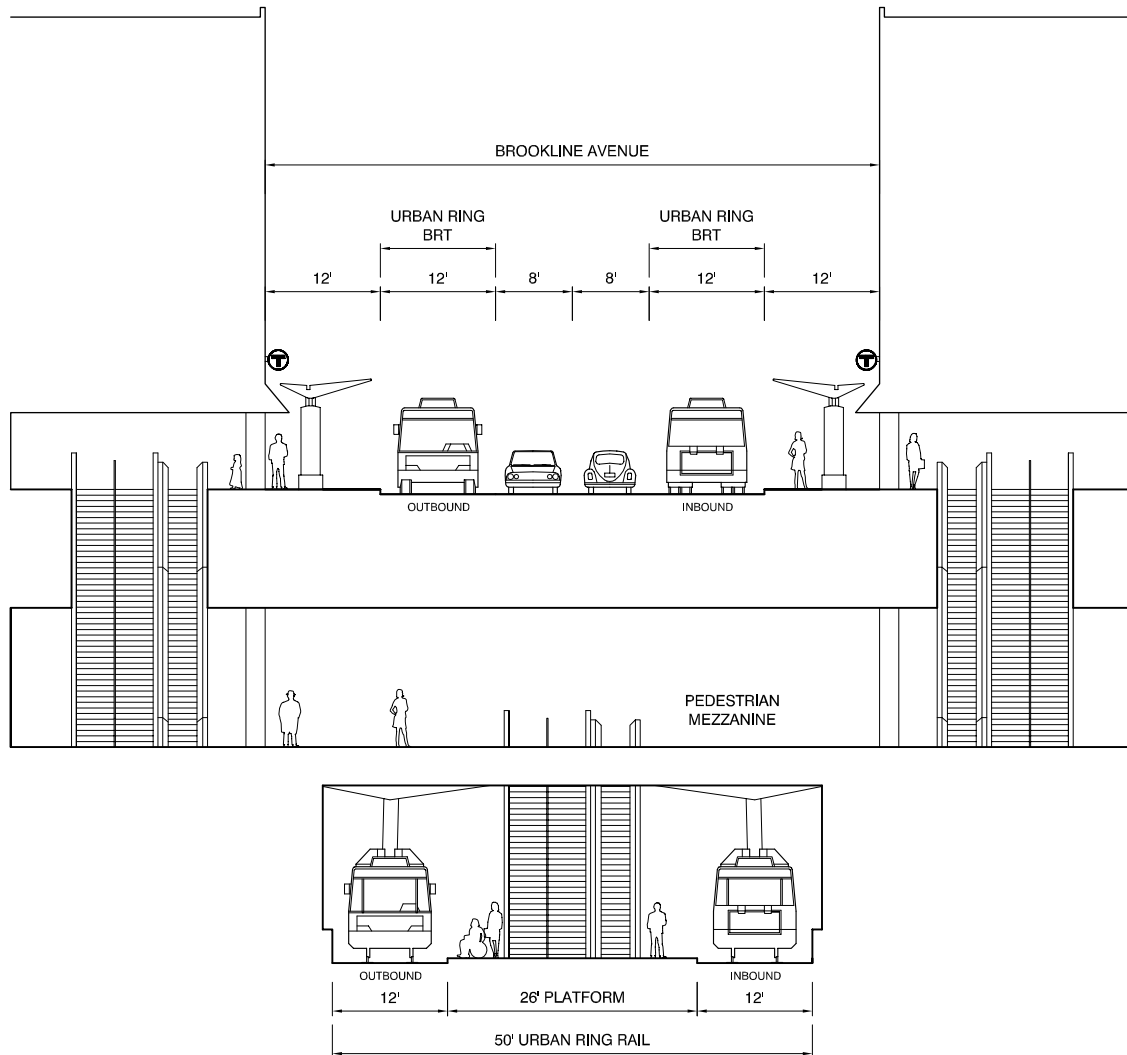
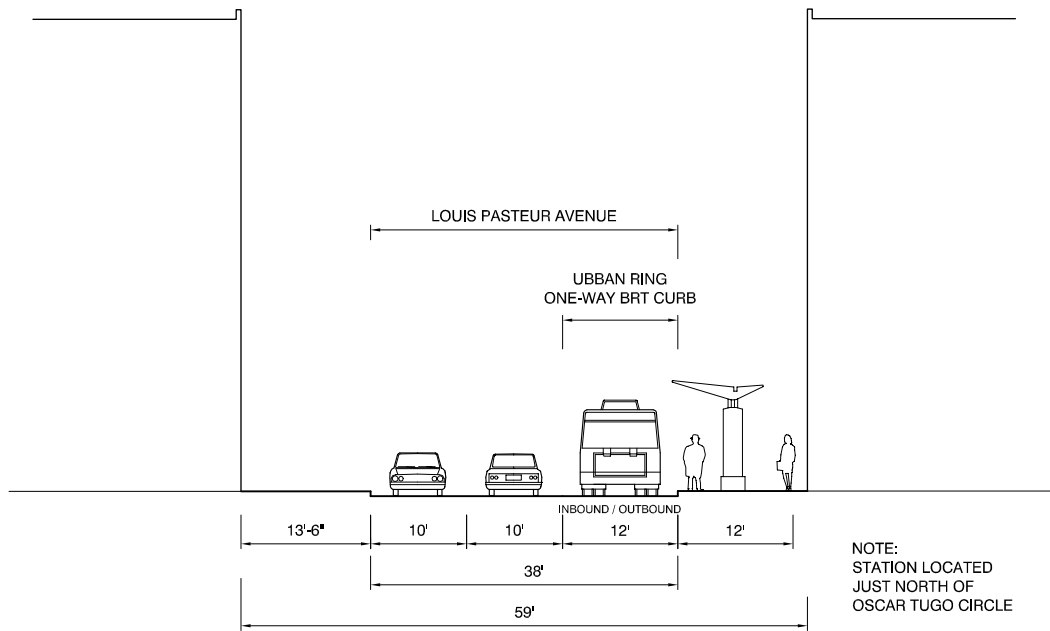


FIGURE 37 BROOKLINE AVENUE / FENWAY URBAN RING STATION (ALT. A1 SHOWN) & ALT. A2
SCALE 1:20 SECTION LOOKING NORTH

Please Note: Station graphics are conceptual only. Actual station locations and configurations will be determined in subsequent environmental and design phases.



FIGURE



LONGWOOD / PASTEUR URBAN RING STATION BRT
SCALE 1:20 SECTION LOOKING SOUTH

Please Note: Station graphics are conceptual only. Actual station locations and configurations will be determined in subsequent environmental and design phases.

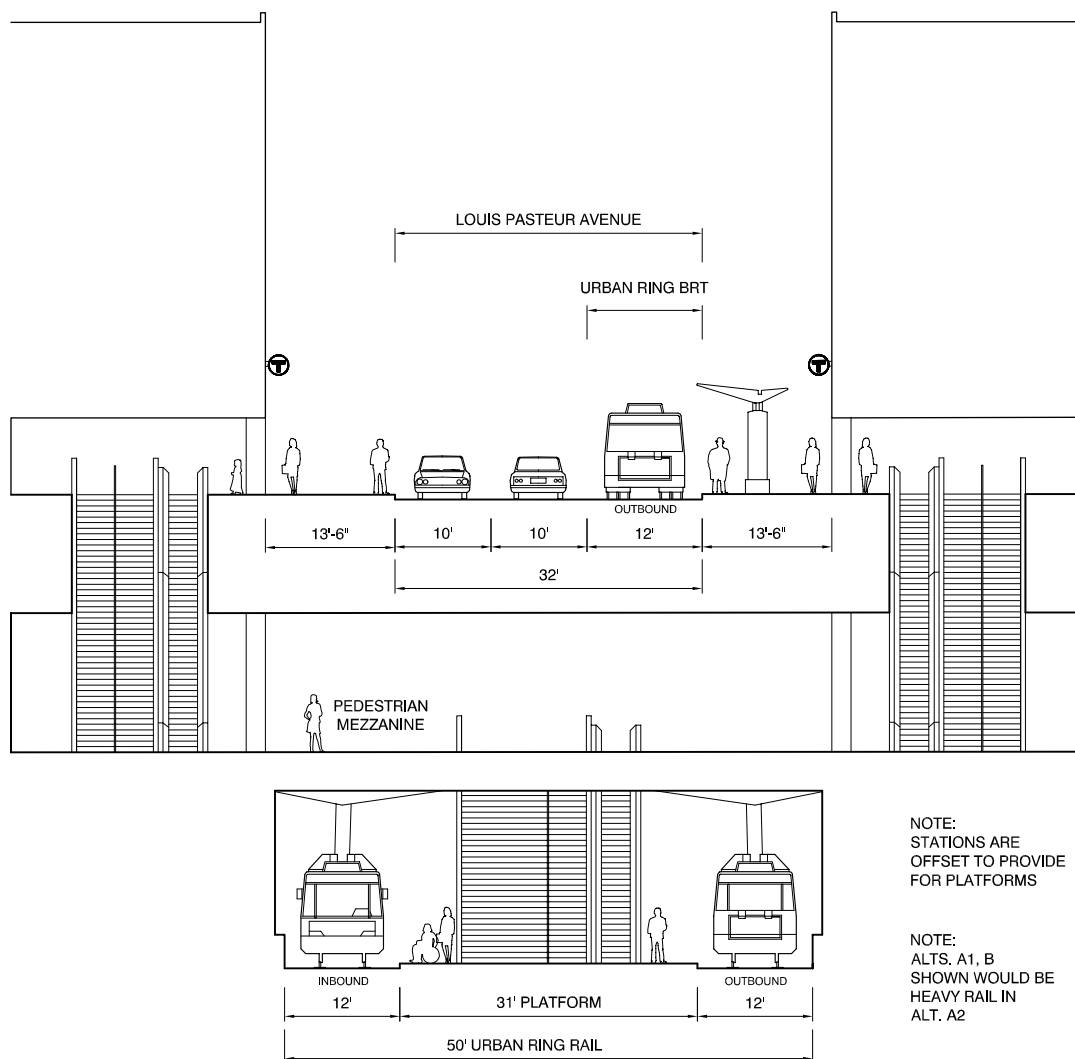


FIGURE 39 LONGWOOD / PASTEUR URBAN RING STATION (ALT. A1 & B SHOWN) & ALT. A2
SCALE 1:20 SECTION LOOKING SOUTH

Please Note: Station graphics are conceptual only. Actual station locations and configurations will be determined in subsequent environmental and design phases.

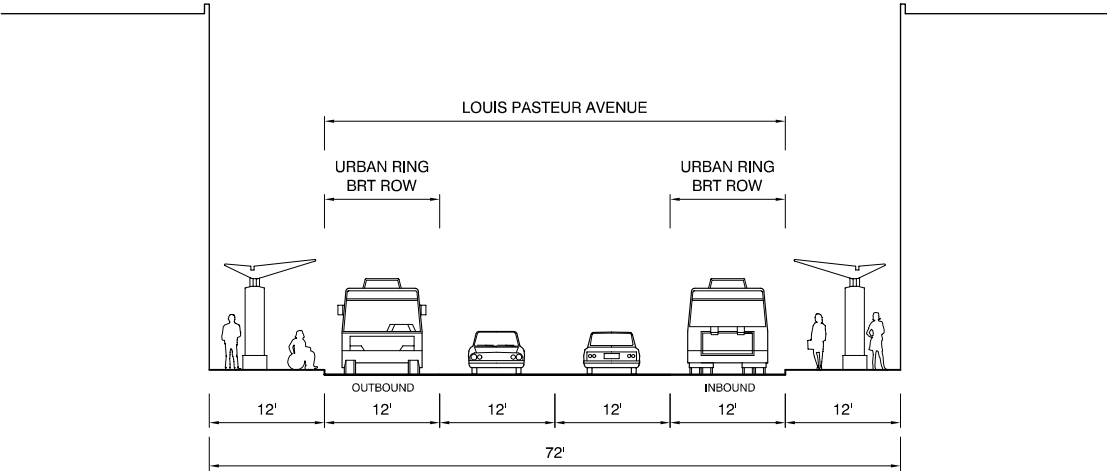


FIGURE 40 FENWAY / PASTEUR URBAN RING STATION BRT
SCALE 1:20 SECTION LOOKING SOUTH

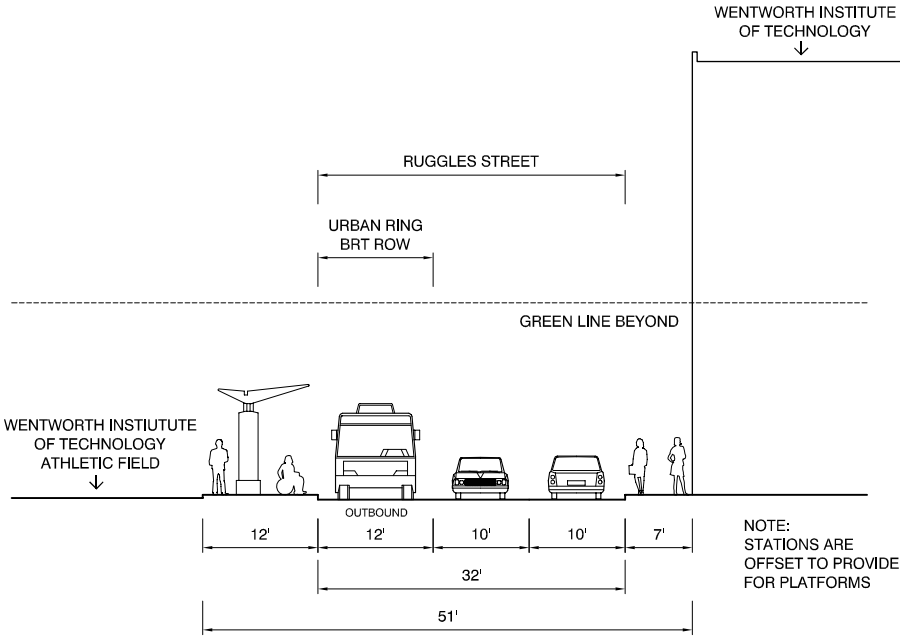


FIGURE 41 RUGGLES STREET AT HUNTINGTON AVENUE URBAN RING STATION BRT
SCALE 1:20 SECTION LOOKING EAST

Please Note: Station graphics are conceptual only. Actual station locations and configurations will be determined in subsequent environmental and design phases.

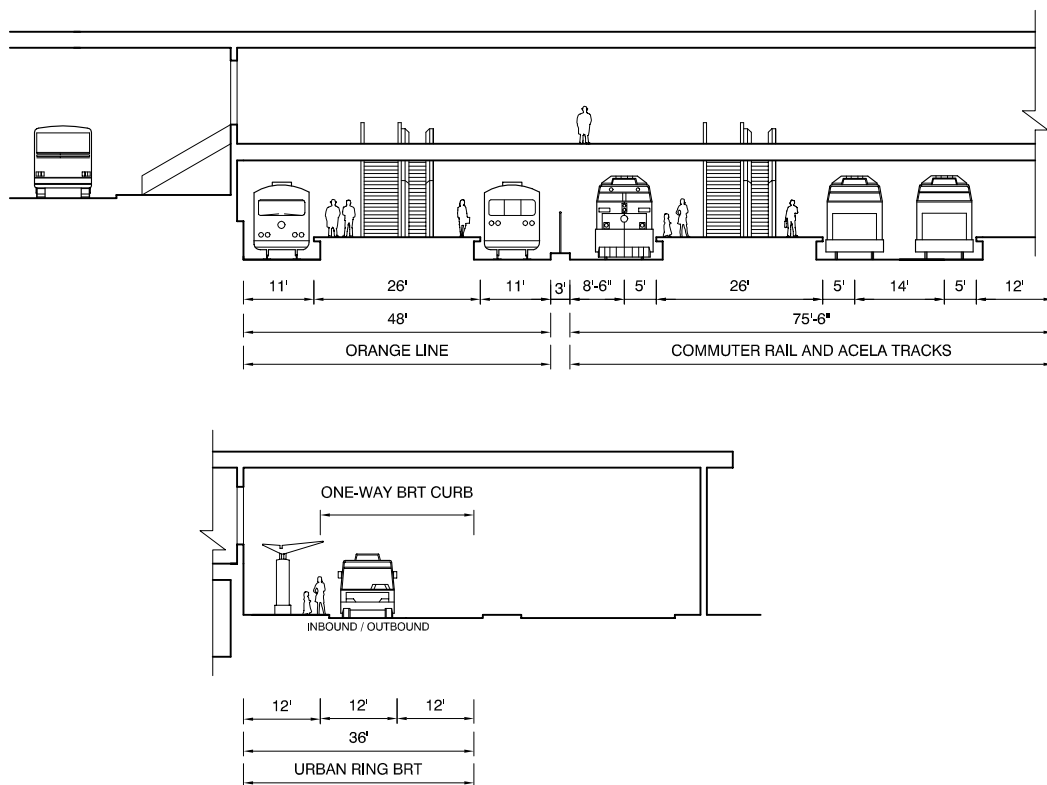


FIGURE
42 RUGGLES URBAN RING STATION BRT
SCALE 1:30 SECTION LOOKING EAST

Please Note: Station graphics are conceptual only. Actual station locations and configurations will be determined in subsequent environmental and design phases.

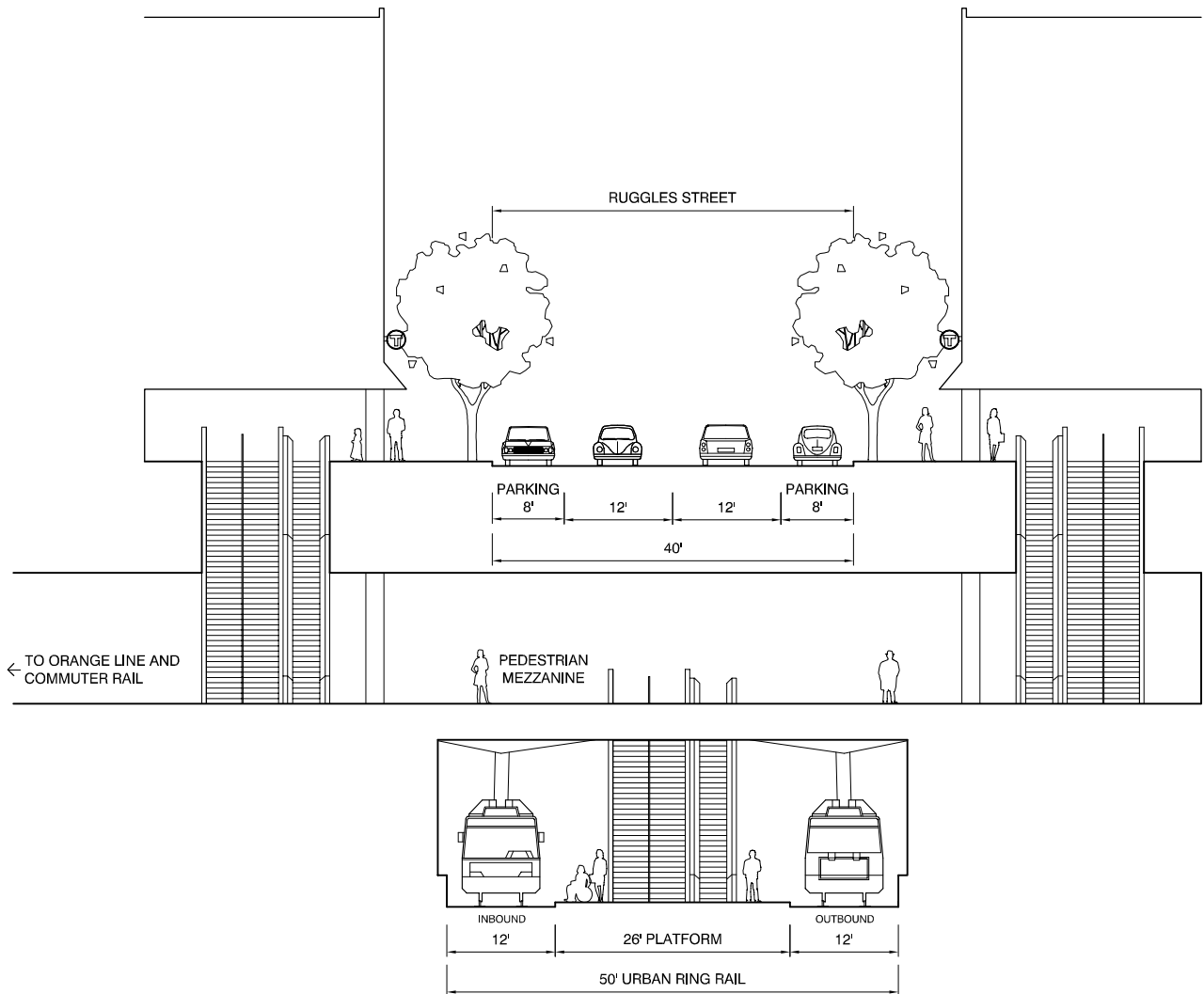
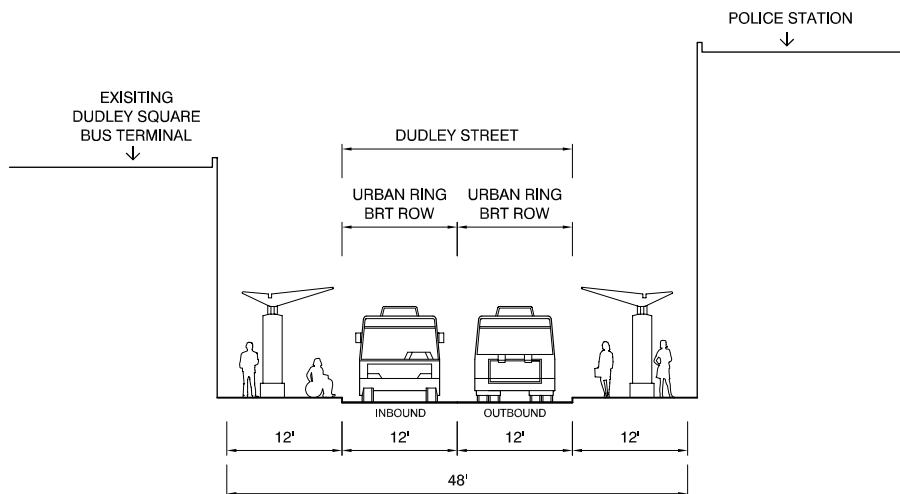


FIGURE
43 RUGGLES URBAN RING STATION (ALT. A1 & B SHOWN) & ALT. A2
SCALE 1:20 SECTION LOOKING EAST

Please Note: Station graphics are conceptual only. Actual station locations and configurations will be determined in subsequent environmental and design phases.



FIGURE



DUDLEY URBAN RING STATION BRT

SCALE 1:20 SECTION LOOKING EAST

Please Note: Station graphics are conceptual only. Actual station locations and configurations will be determined in subsequent environmental and design phases.

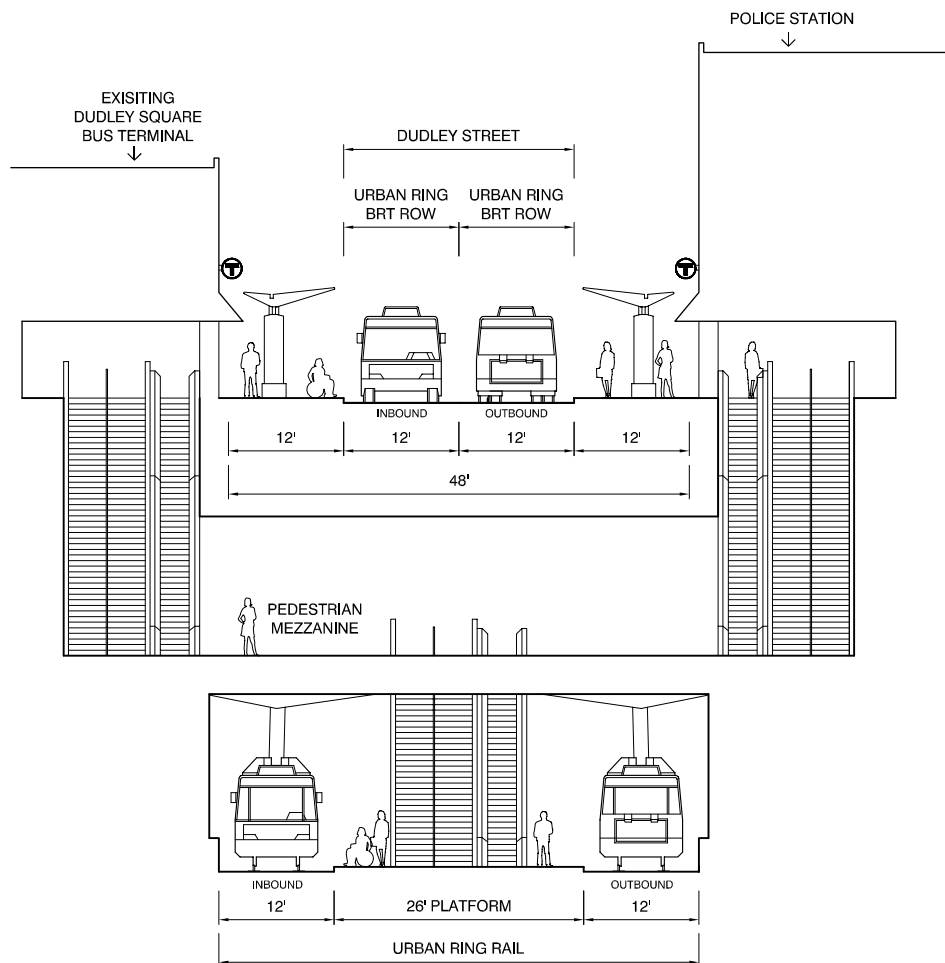


FIGURE
45 DUDLEY URBAN RING STATION (ALT. A1 & B SHOWN) & ALT. A2
SCALE 1:20 SECTION LOOKING EAST

Please Note: Station graphics are conceptual only. Actual station locations and configurations will be determined in subsequent environmental and design phases.

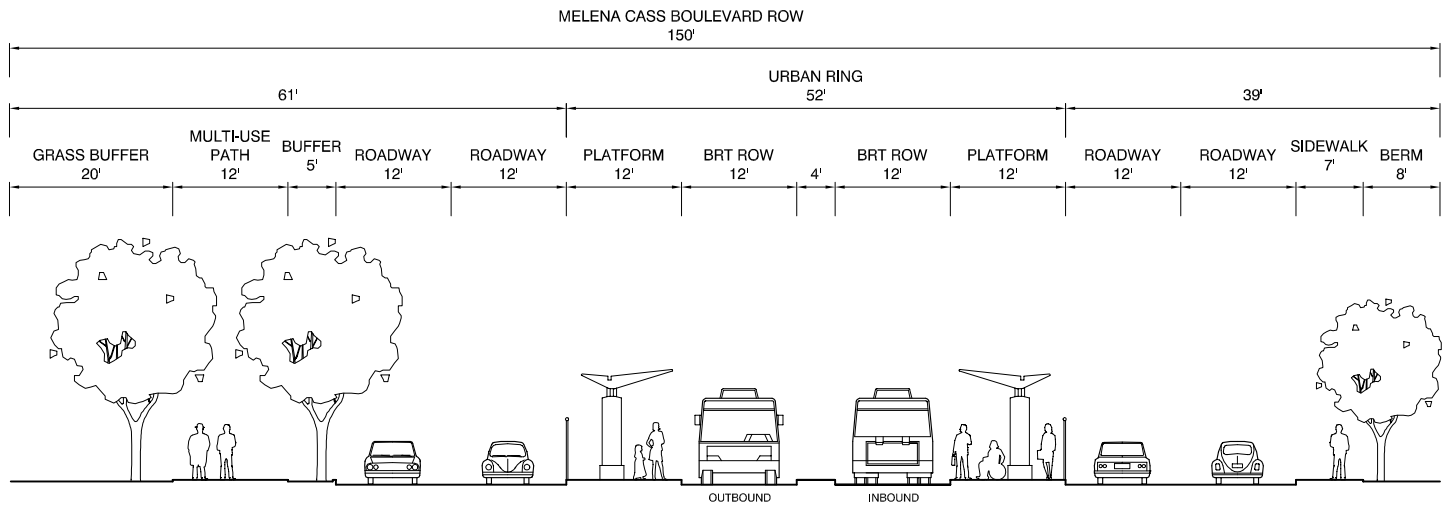


FIGURE 46 MELNEA CASS BOULEVARD / SILVER LINE URBAN RING STATION BRT
SCALE 1:20 OPTION A - SECTION LOOKING WEST

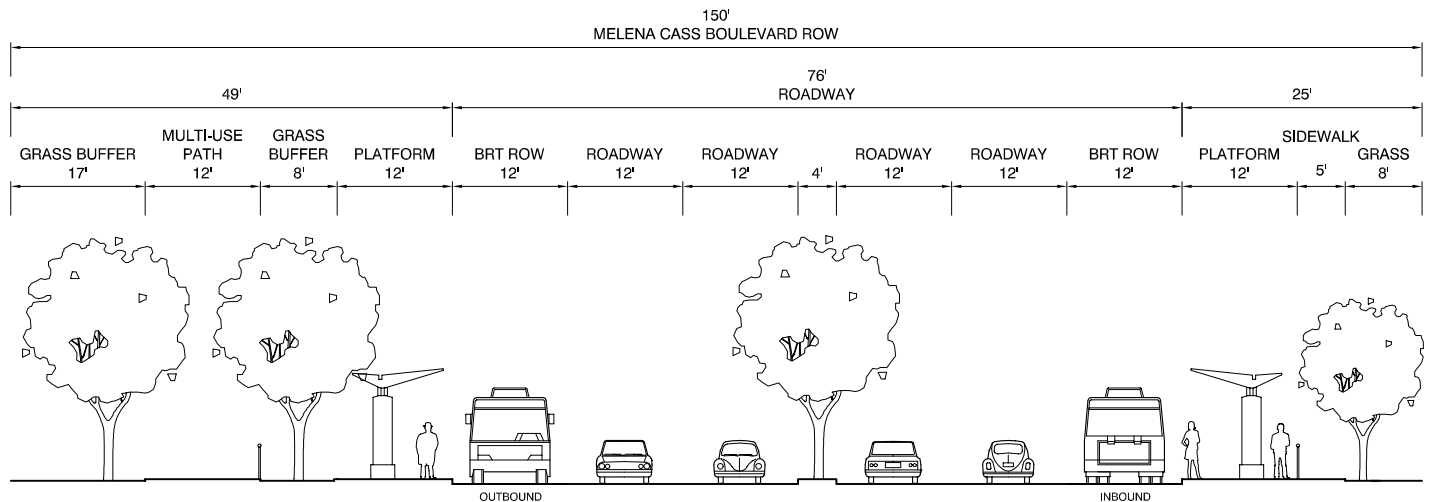


FIGURE 47 MELNEA CASS BOULEVARD / SILVER LINE URBAN RING STATION BRT
SCALE 1:20 OPTION B - SECTION LOOKING WEST

Please Note: Station graphics are conceptual only. Actual station locations and configurations will be determined in subsequent environmental and design phases.

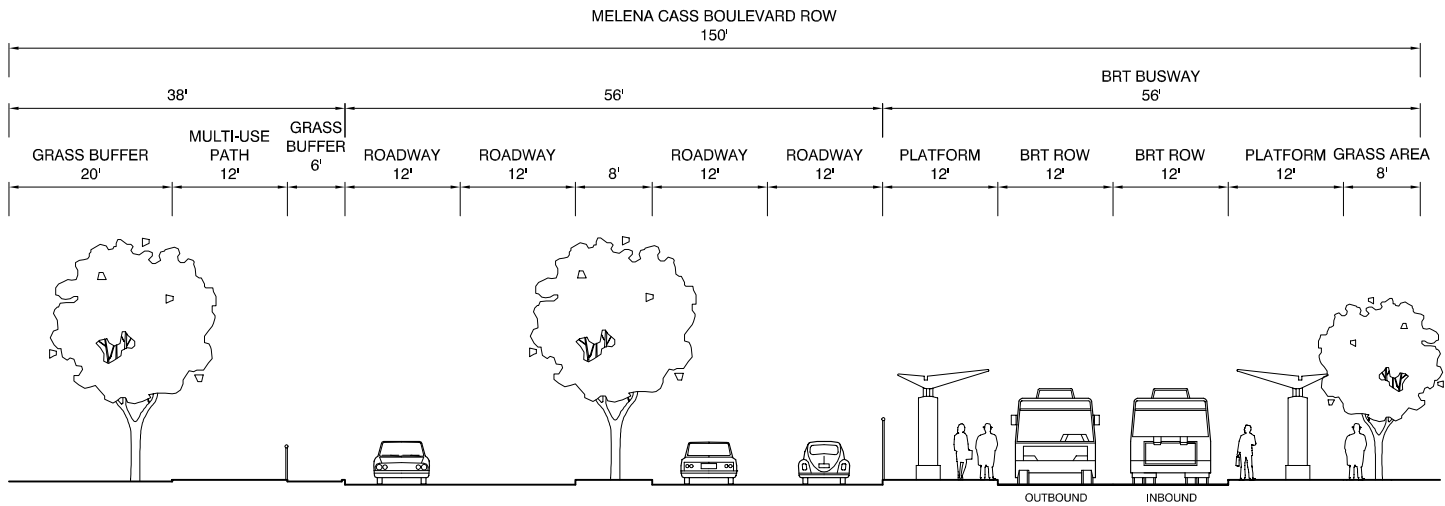


FIGURE
48 MELNEA CASS BOULEVARD / SILVER LINE URBAN RING STATION BRT
SCALE 1:20 OPTION C - SECTION LOOKING WEST

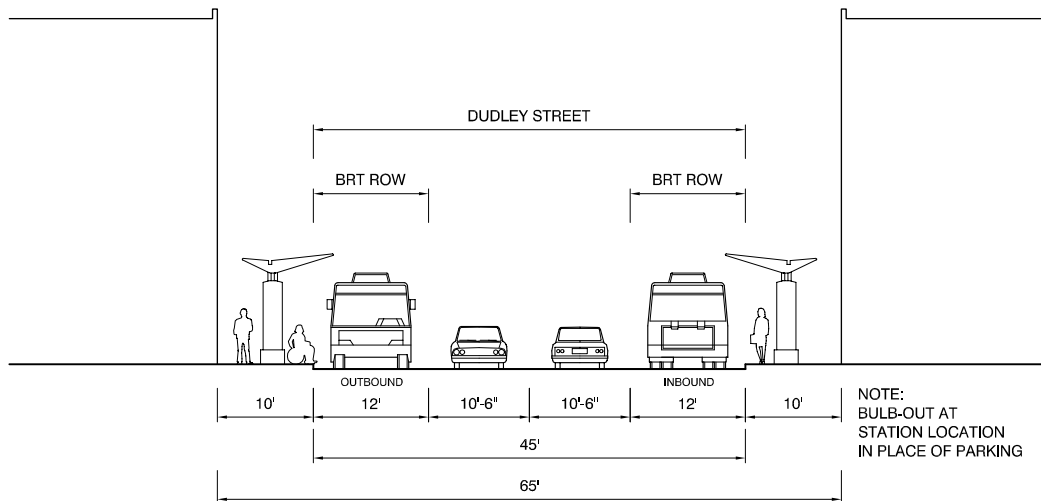


FIGURE
49 BLUE HILL AVENUE URBAN RING STATION BRT
SCALE 1:20 SECTION LOOKING NORTH

Please Note: Station graphics are conceptual only. Actual station locations and configurations will be determined in subsequent environmental and design phases.

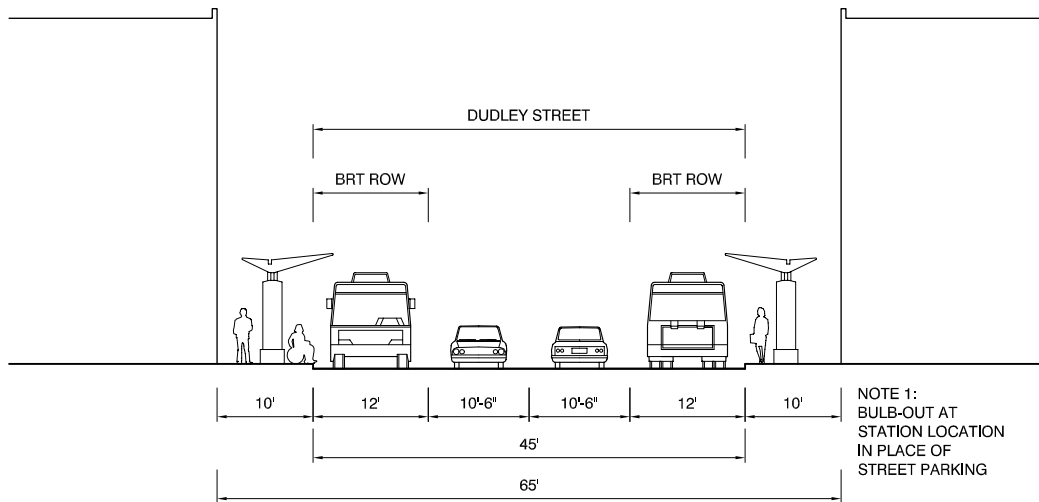


FIGURE
50 UPHAMS CORNERS URBAN RING STATION BRT
SCALE 1:20 SECTION LOOKING WEST

NOTE 2:
STATION WOULD BE
JUST EAST OR WEST
OF COMMUTER RAIL
STATION

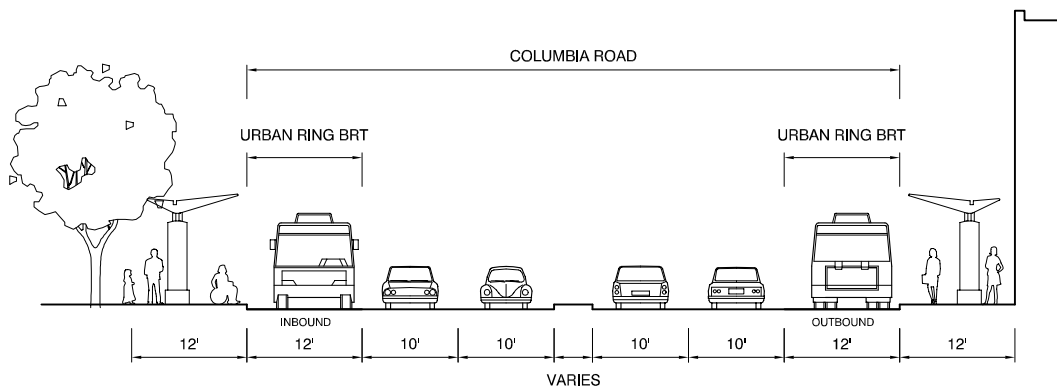


FIGURE
51 EDWARD EVERETT SQUARE BRT
SCALE 1:20 SECTION LOOKING WEST

Please Note: Station graphics are conceptual only. Actual station locations and configurations will be determined in subsequent environmental and design phases.

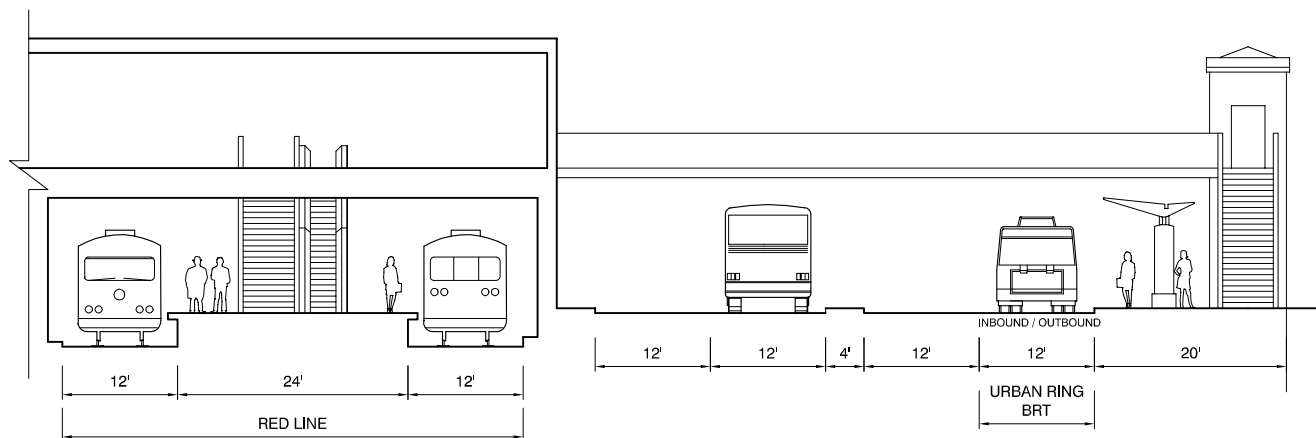


FIGURE
52 JFK / UMASS URBAN RING STATION BRT
SCALE 1:20 SECTION LOOKING NORTH

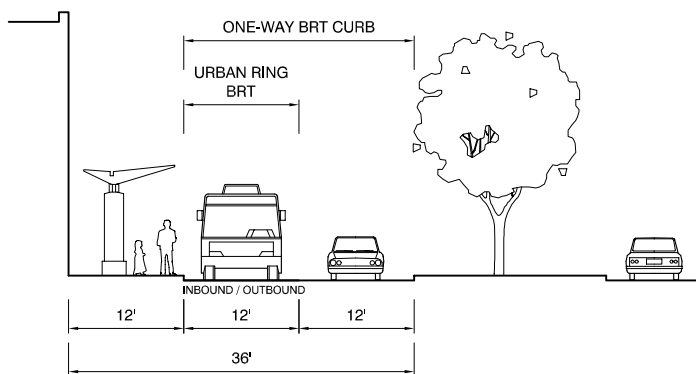


FIGURE
53 UMASS CAMPUS URBAN RING STATION BRT
SCALE 1:20 SECTION LOOKING NORTH

Please Note: Station graphics are conceptual only. Actual station locations and configurations will be determined in subsequent environmental and design phases.

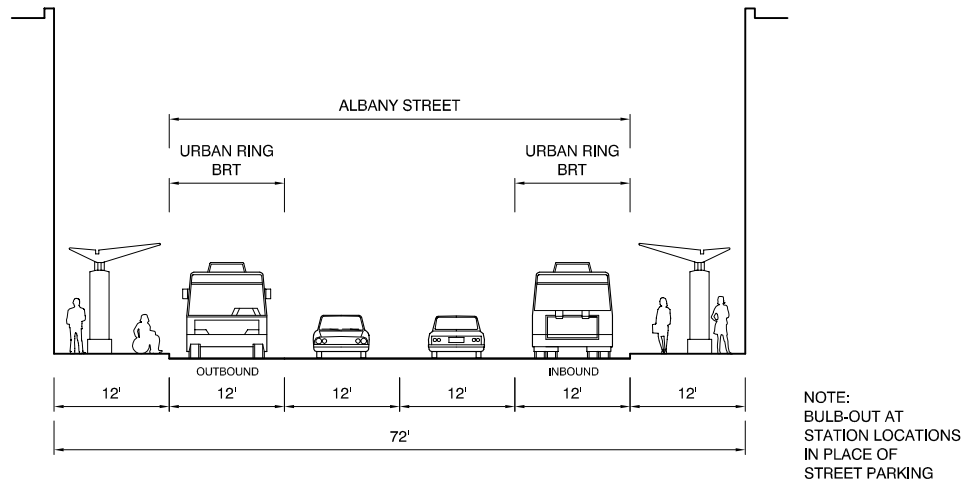


FIGURE 54 CROSSTOWN / ALBANY URBAN RING STATION BRT
SCALE 1:20 SECTION LOOKING WEST

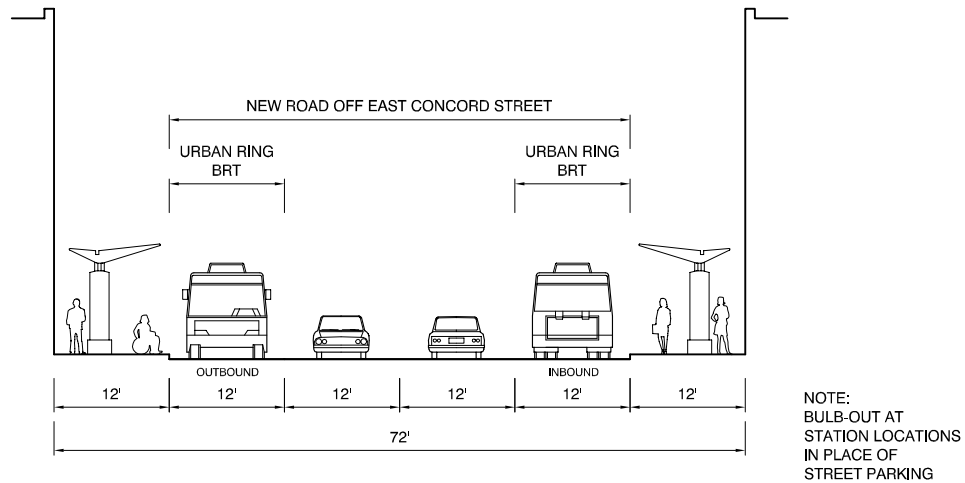


FIGURE 55 BIOSQUARE URBAN RING STATION BRT
SCALE 1:20 SECTION LOOKING WEST

Please Note: Station graphics are conceptual only. Actual station locations and configurations will be determined in subsequent environmental and design phases.

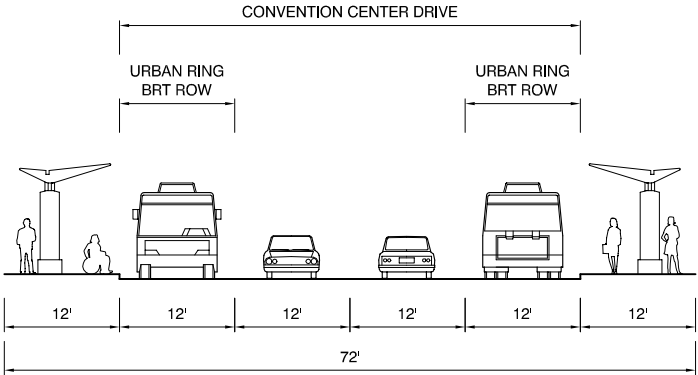


FIGURE
56 CONVENTION CENTER URBAN RING STATION BRT
SCALE 1:20

Please Note: Station graphics are conceptual only. Actual station locations and configurations will be determined in subsequent environmental and design phases.